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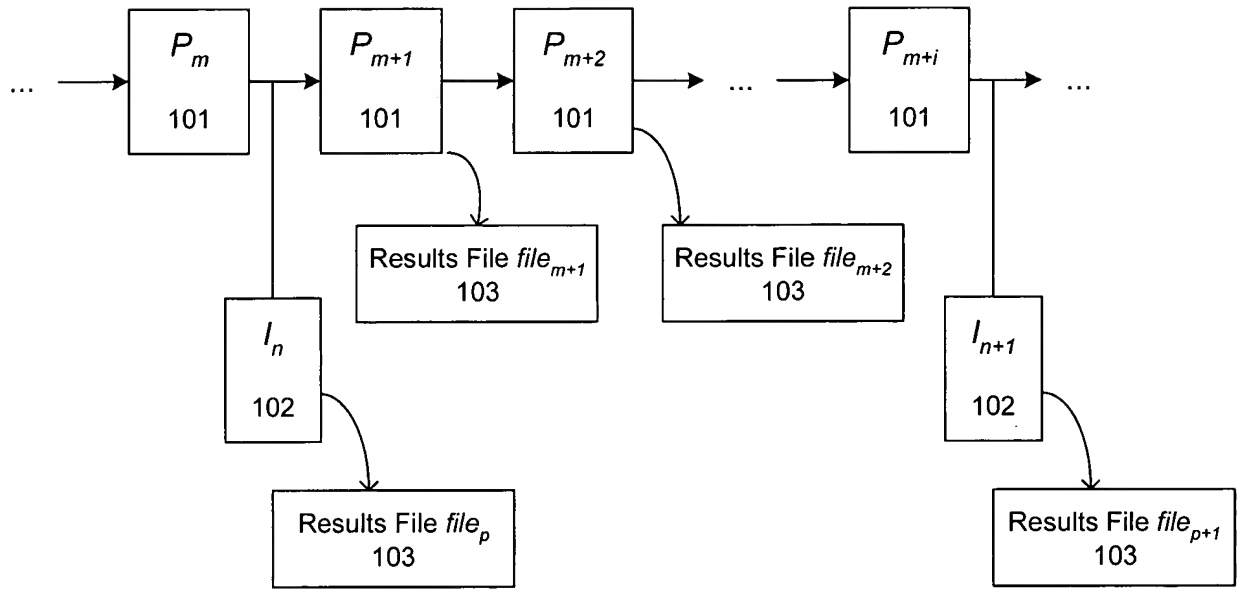

P_m
101
P_{m+1}
101
P_{m+2}
101
P_{m+i}
101
Results File $file_{m+1}$
103
Results File $file_{m+2}$
103
I_n
102
I_{n+1}
102
Results File $file_p$
103
Results File $file_{p+1}$
103

Figure 1

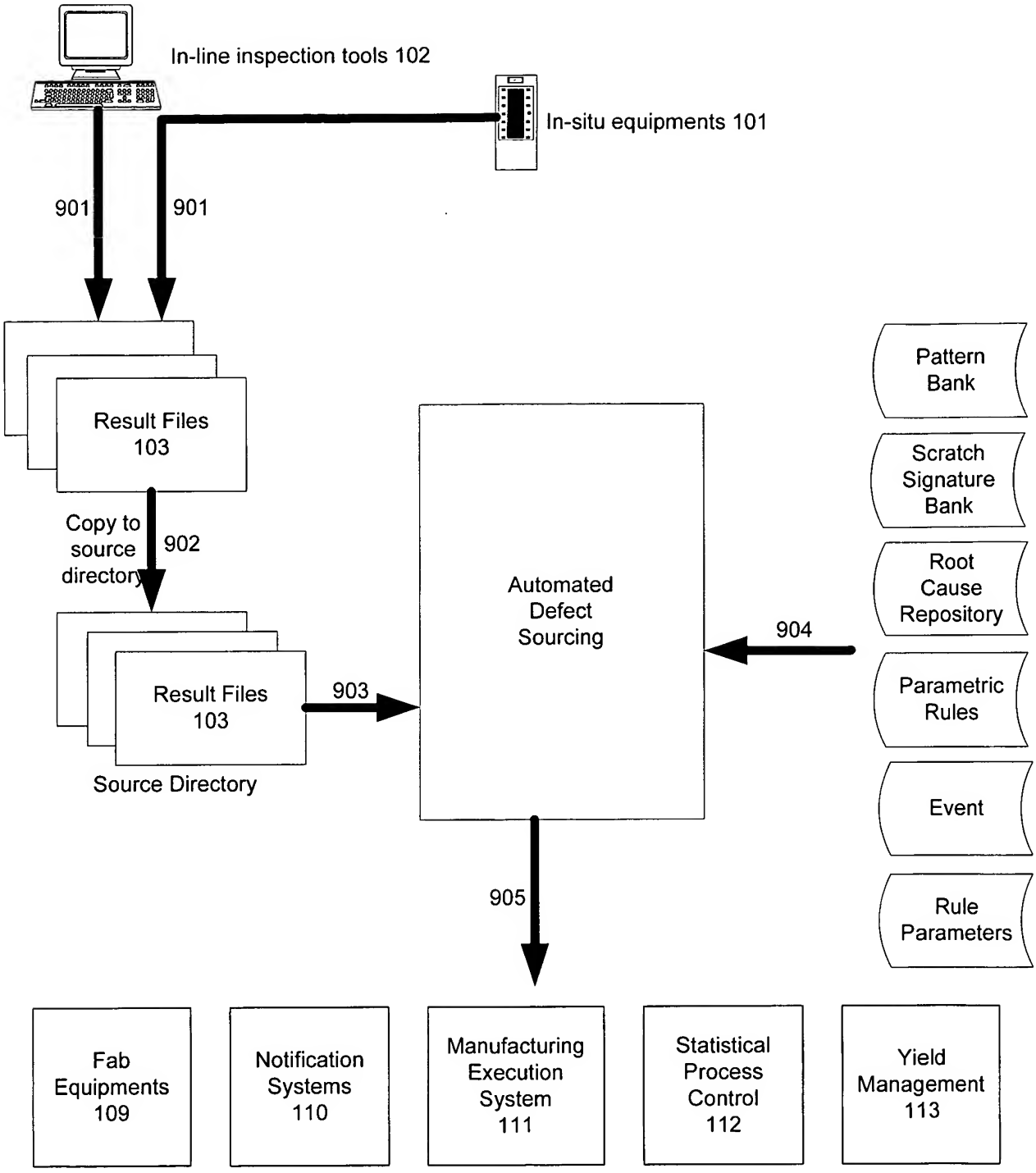

In-line inspection tools 102
In-situ equipments 101
901
901
Result Files 103
Copy to source directory
902
Result Files 103
Source Directory
903
Automated Defect Sourcing
904
Pattern Bank
Scratch Signature Bank
Root Cause Repository
Parametric Rules
Event
Rule Parameters
905
Fab Equipments 109
Notification Systems 110
Manufacturing Execution System 111
Statistical Process Control 112
Yield Management 113

Figure 1a

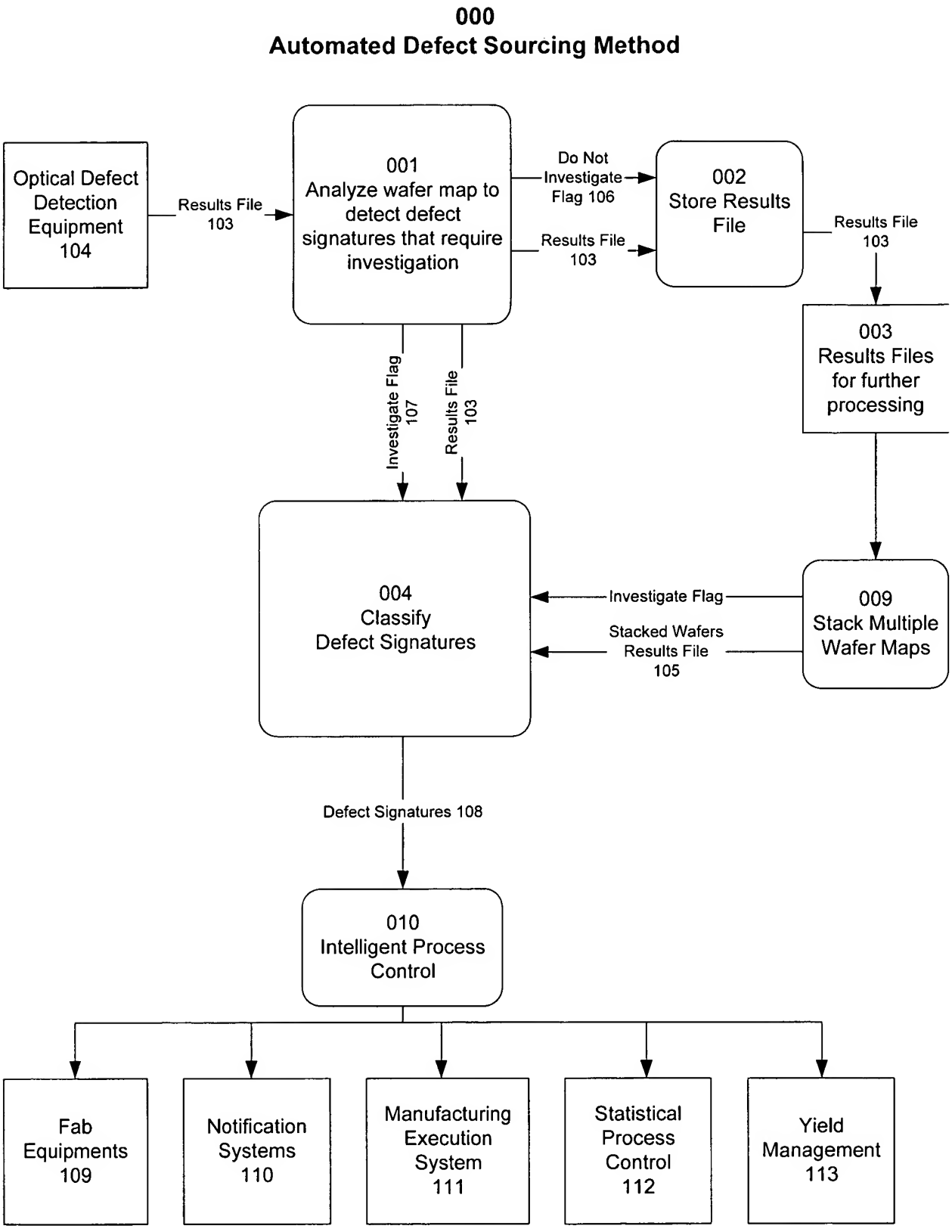
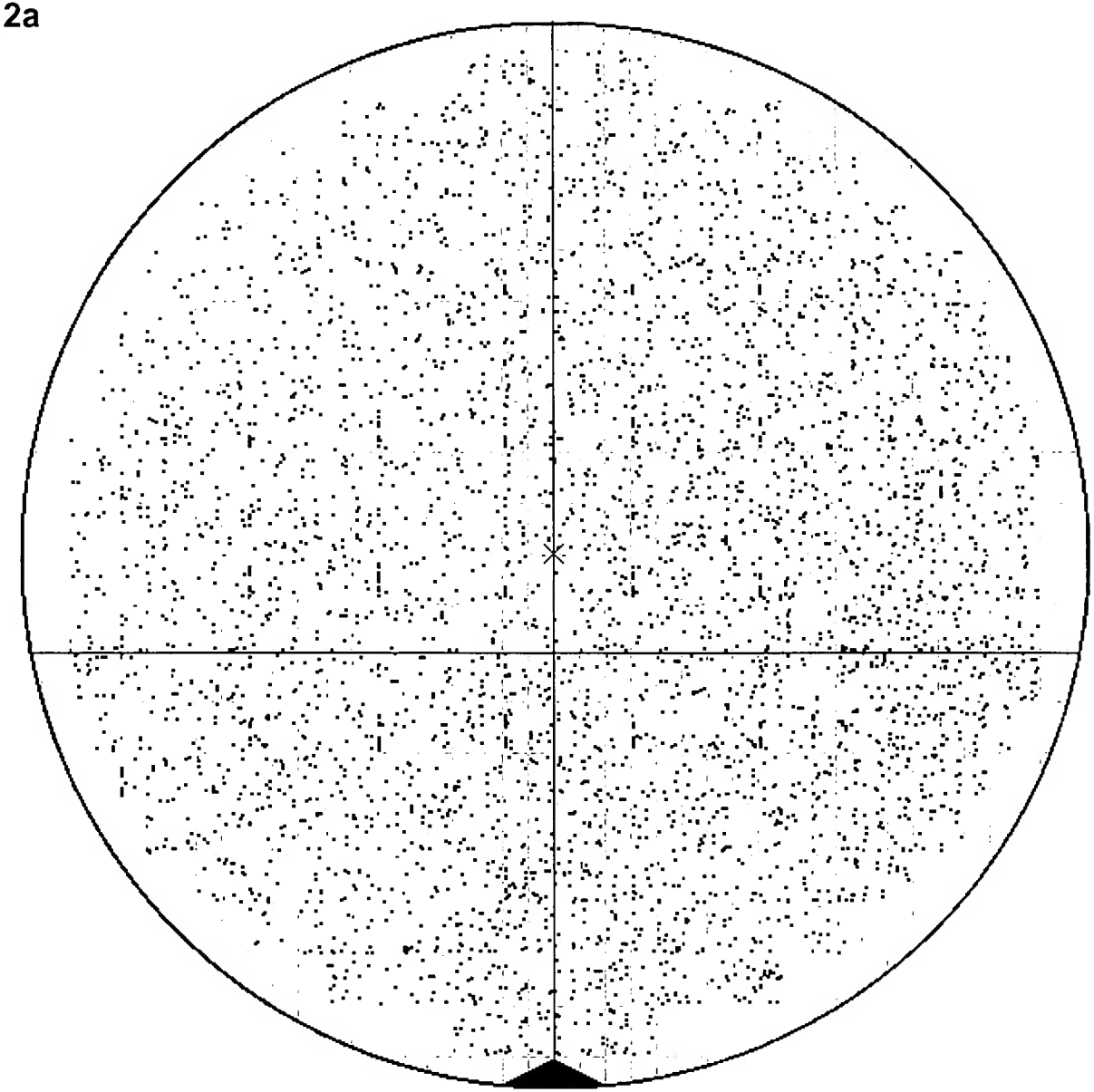

000
Automated Defect Sourcing Method
Optical Defect Detection Equipment 104
Results File 103
001 Analyze wafer map to detect defect signatures that require investigation
Do Not Investigate Flag 106
Results File 103
002 Store Results File
Results File 103
003 Results Files for further processing
Investigate Flag 107
Results File 103
004 Classify Defect Signatures
Investigate Flag
Stacked Wafers Results File 105
009 Stack Multiple Wafer Maps
Defect Signatures 108
010 Intelligent Process Control
Fab Equipments 109
Notification Systems 110
Manufacturing Execution System 111
Statistical Process Control 112
Yield Management 113

Figure 2

Figure 2a



001
Method to Detect Defect Patterns That Require Investigation

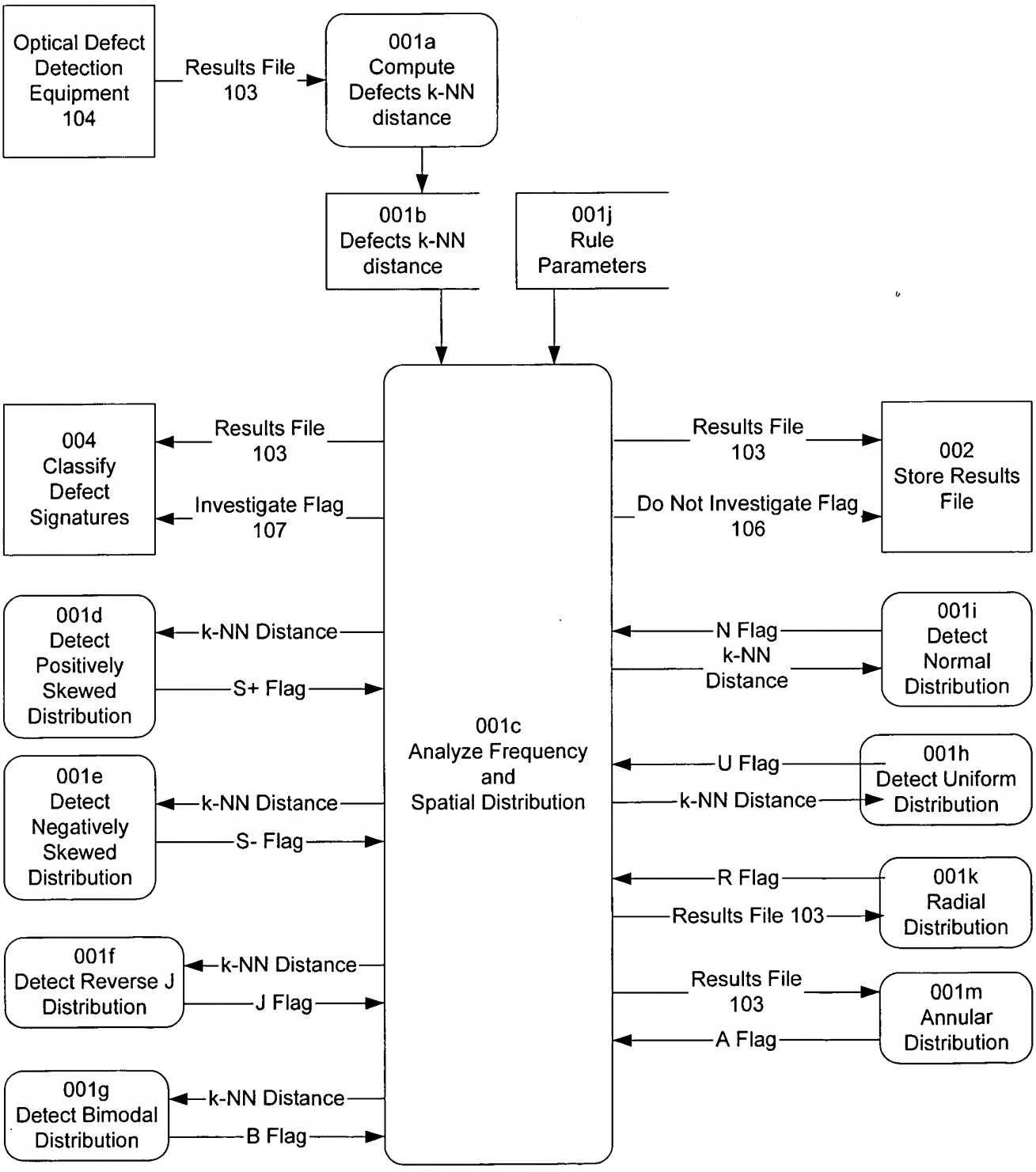


Figure 3

Figure 3a

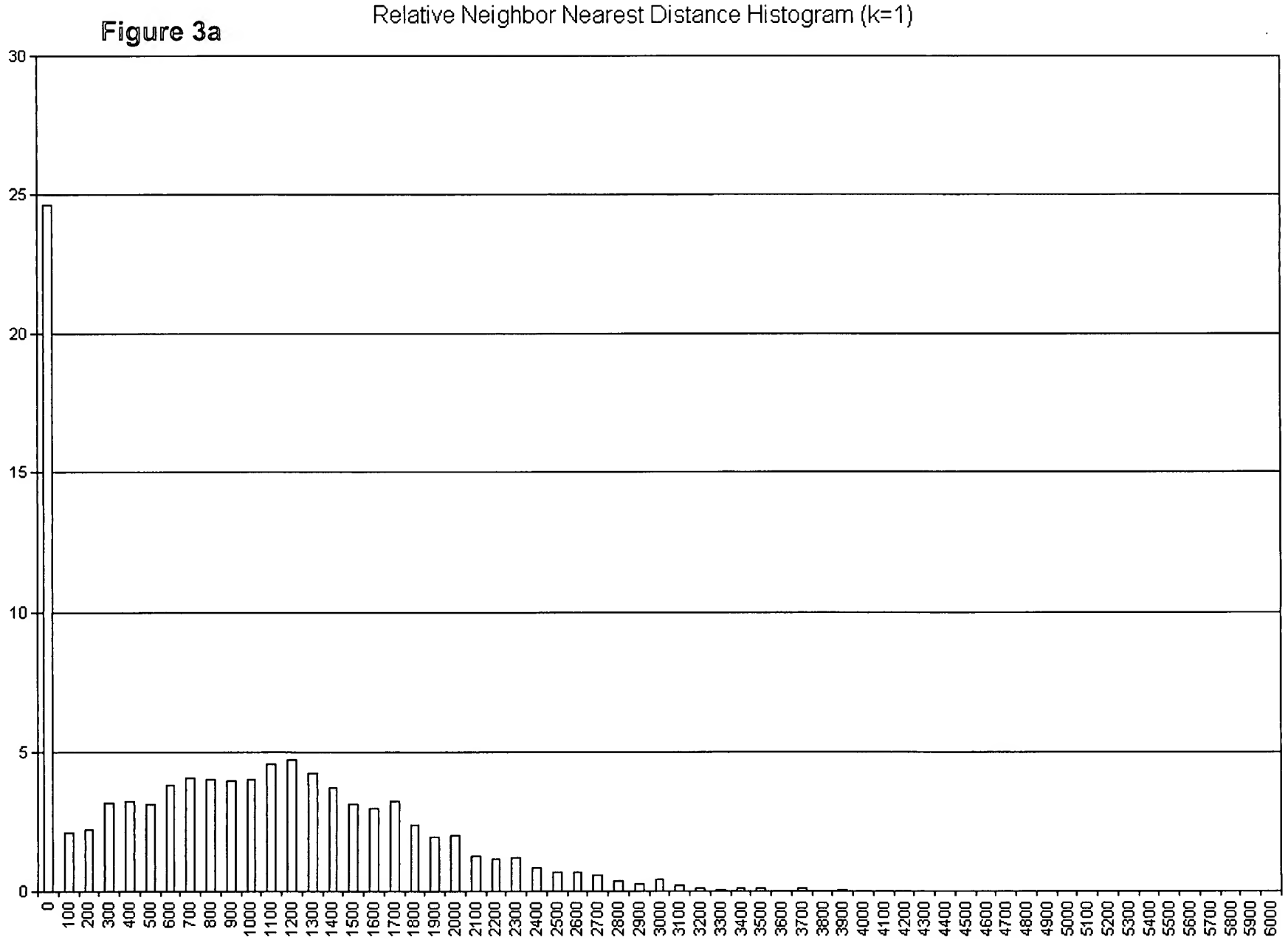

Relative Neighbor Nearest Distance Histogram (k=1)
30
25
20
15
10
5
0
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
3100
3200
3300
3400
3500
3600
3700
3800
3900
4000
4100
4200
4300
4400
4500
4600
4700
4800
4900
5000
5100
5200
5300
5400
5500
5600
5700
5800
5900
6000

Figure 3b

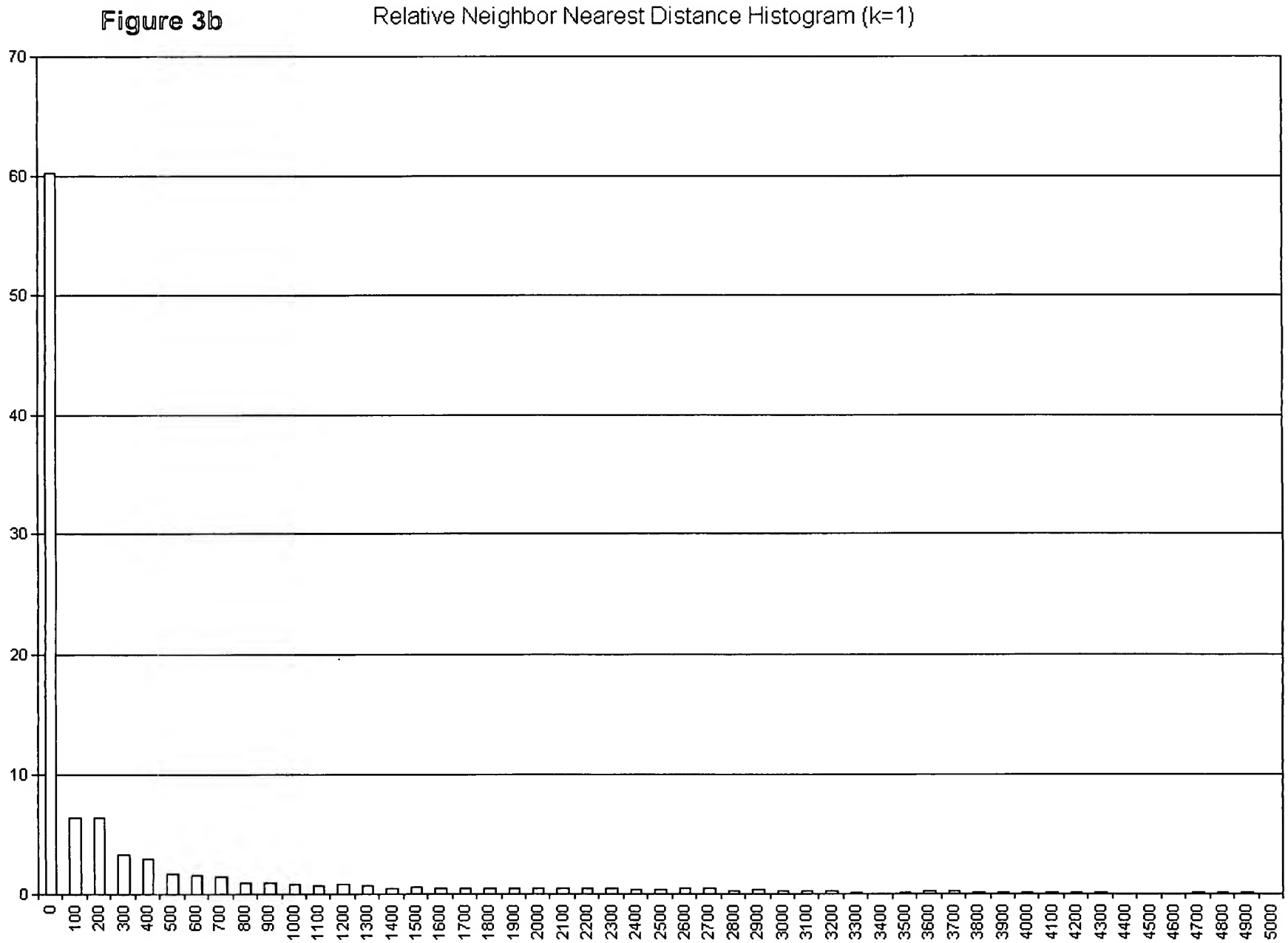

Relative Neighbor Nearest Distance Histogram (k=1)
70
60
50
40
30
20
10
0
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
3100
3200
3300
3400
3500
3600
3700
3800
3900
4000
4100
4200
4300
4400
4500
4600
4700
4800
4900
5000

Figure 3c

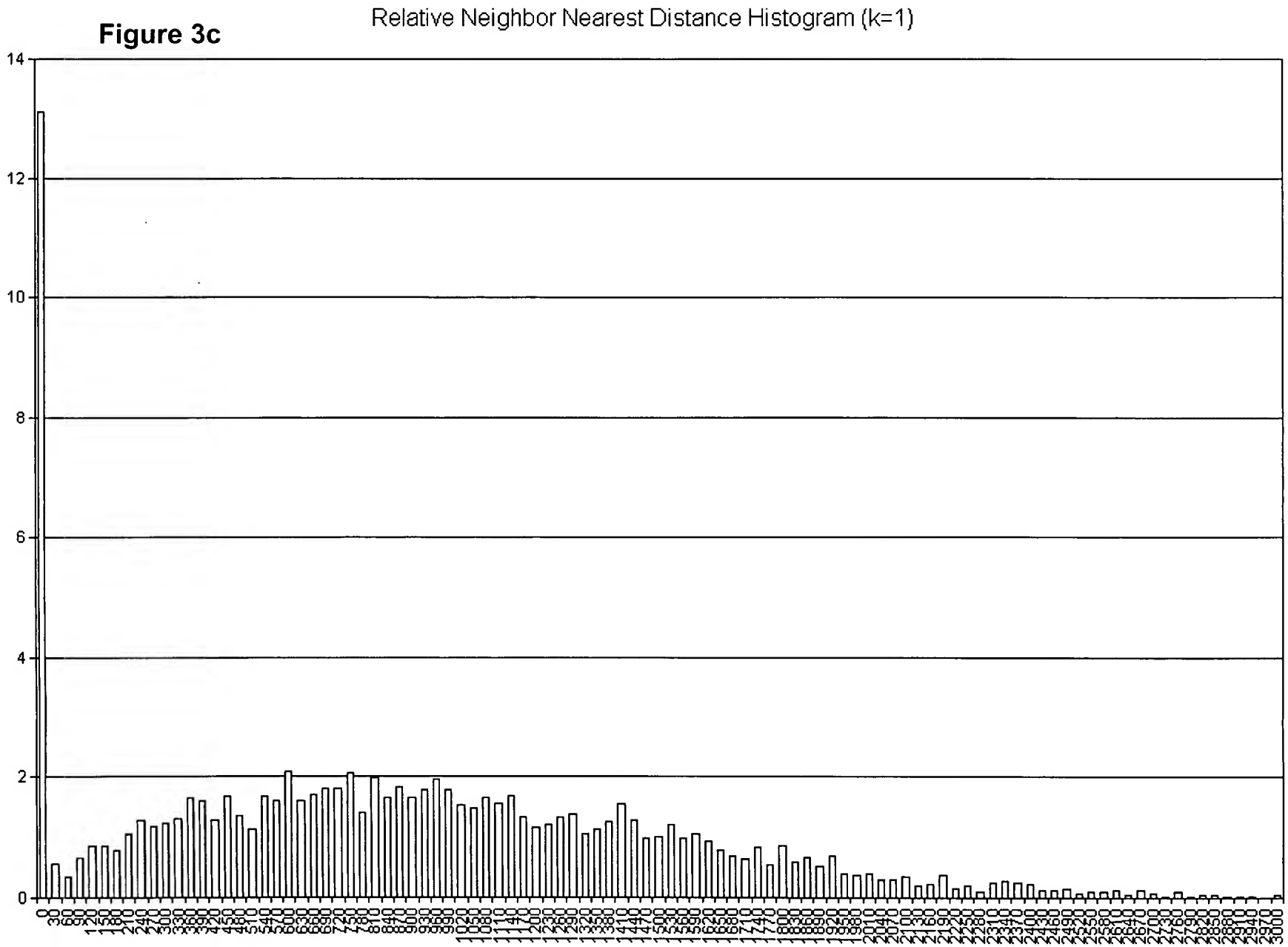

Relative Neighbor Nearest Distance Histogram (k=1)
14
12
10
8
6
4
2
0

Figure 3d

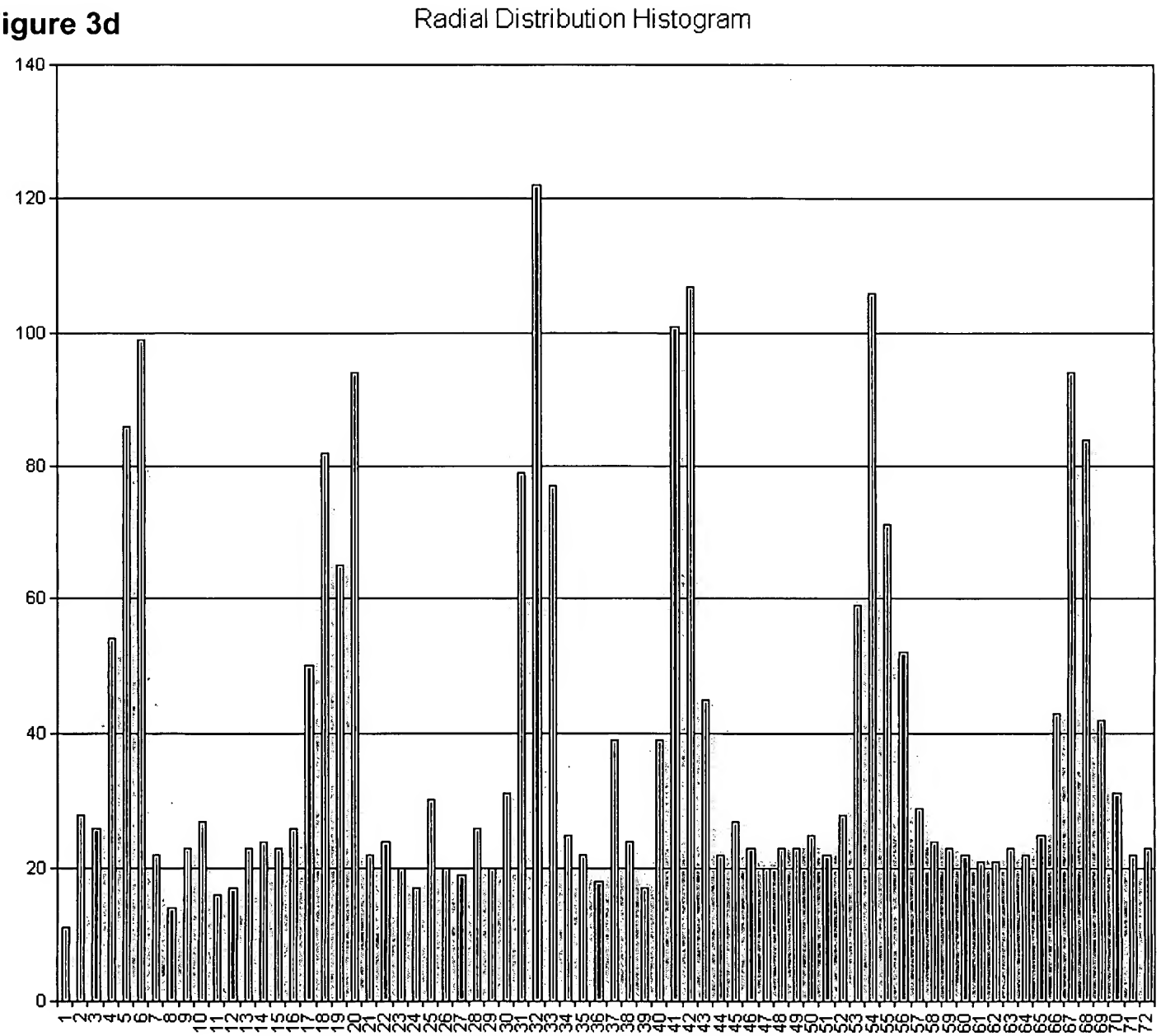

Radial Distribution Histogram
140
120
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72

Figure 3e

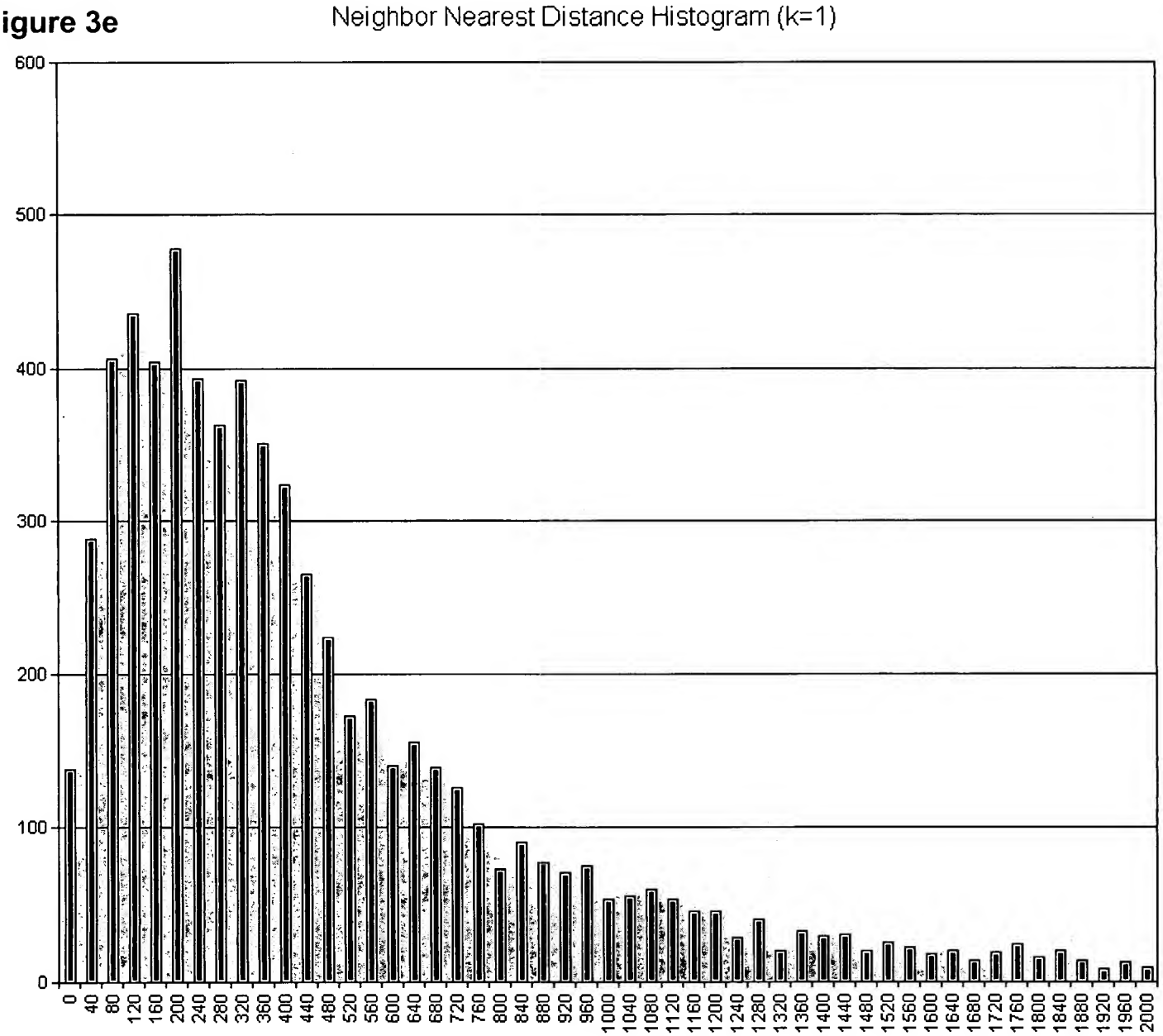

Neighbor Nearest Distance Histogram (k=1)
600
500
400
300
200
100
0
0
40
80
120
160
200
240
280
320
360
400
440
480
520
560
600
640
680
720
760
800
840
880
920
960
1000
1040
1080
1120
1160
1200
1240
1280
1320
1360
1400
1440
1480
1520
1560
1600
1640
1680
1720
1760
1800
1840
1880
1920
1960
2000

Figure 3f

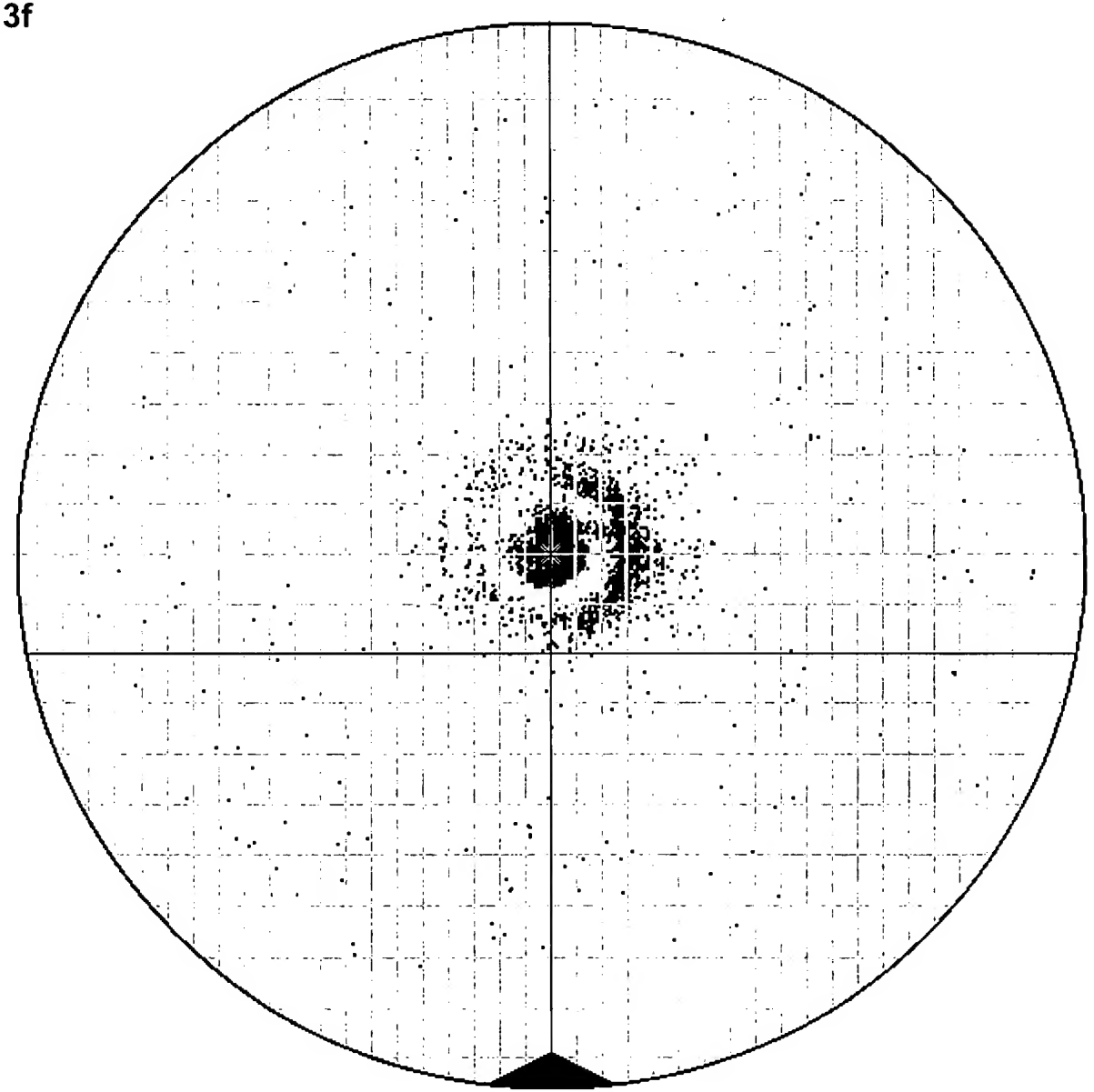


Figure 3g

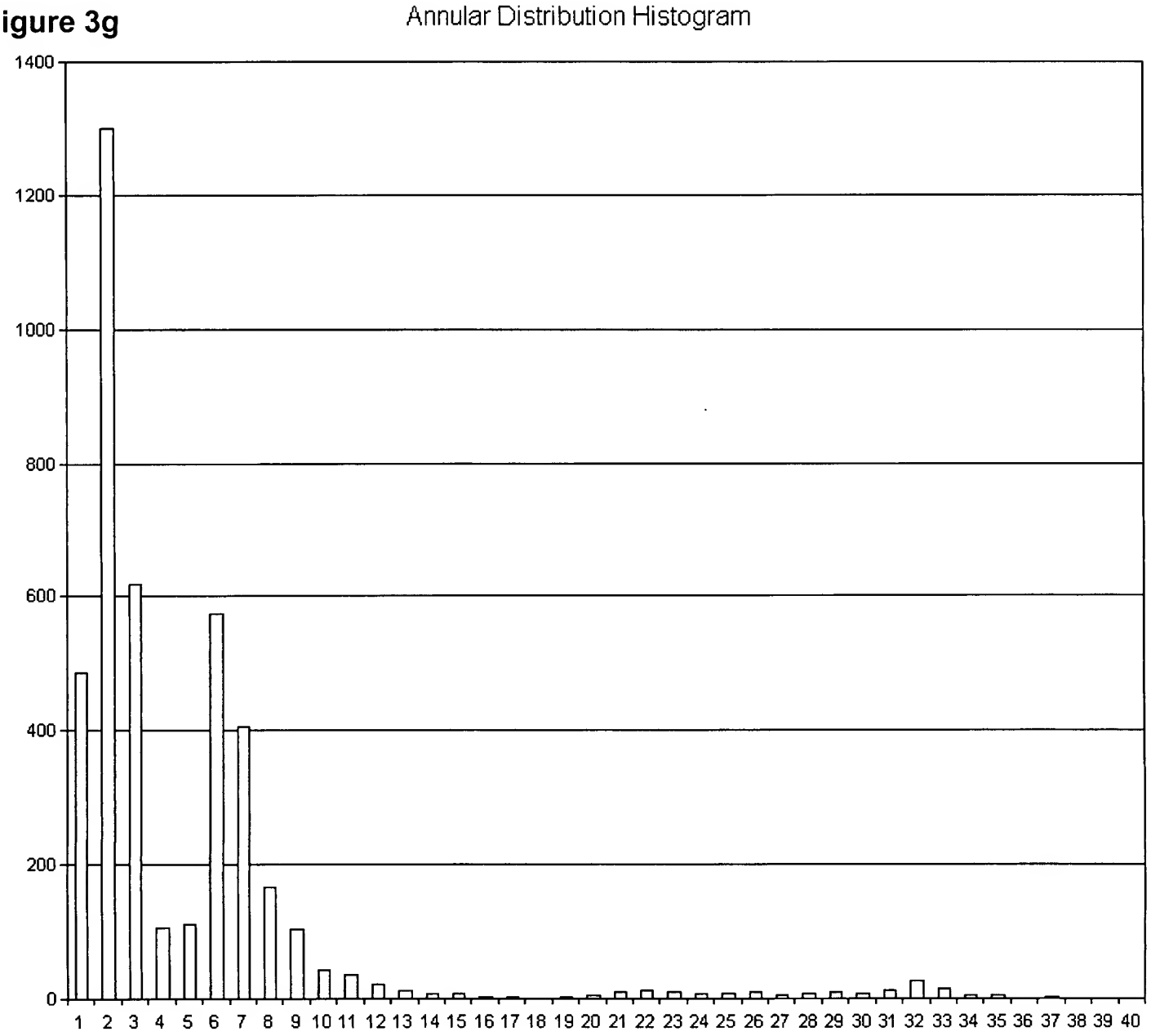

Annular Distribution Histogram
1400
1200
1000
800
600
400
200
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

Figure 3h

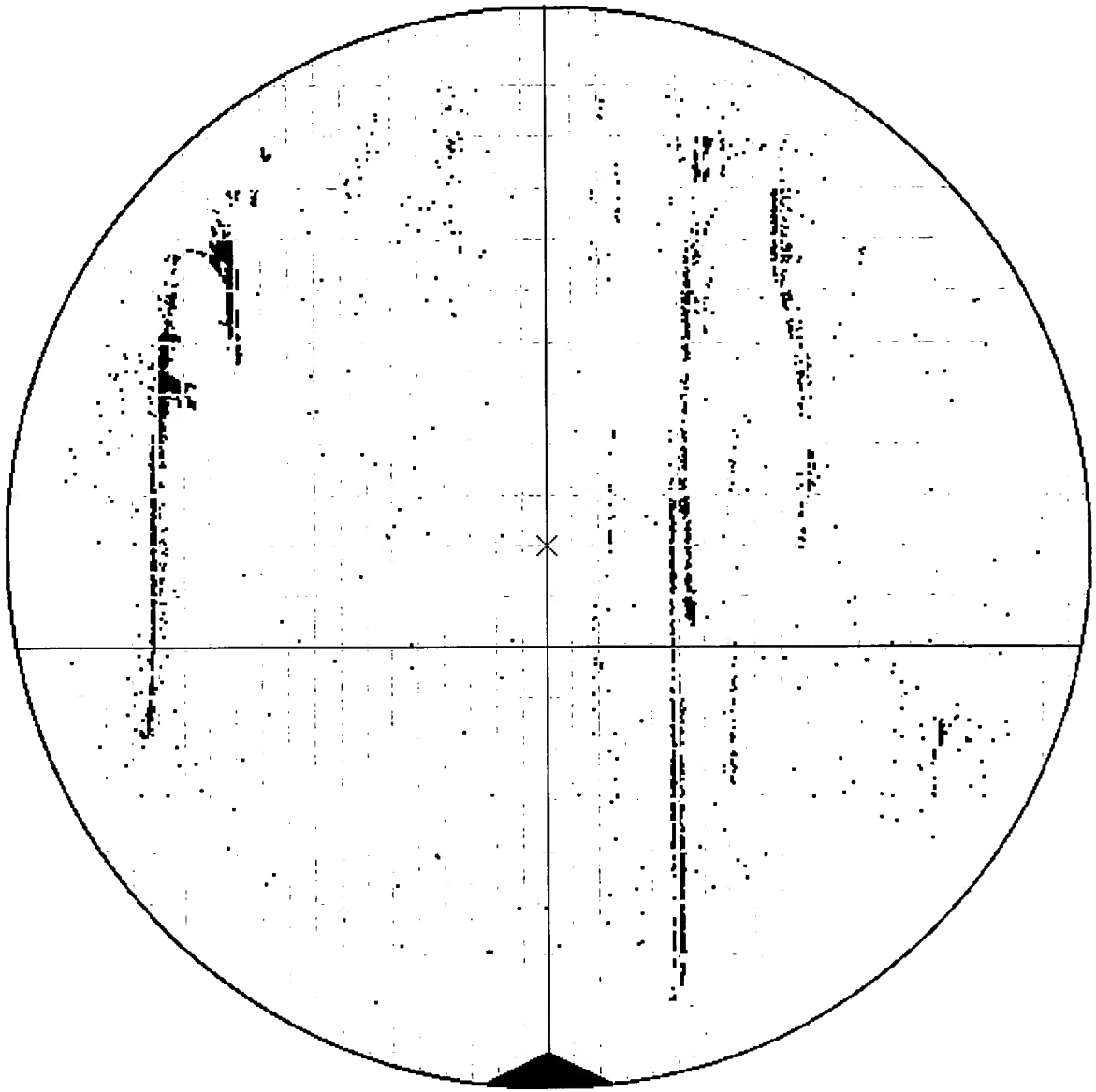


Figure 3i

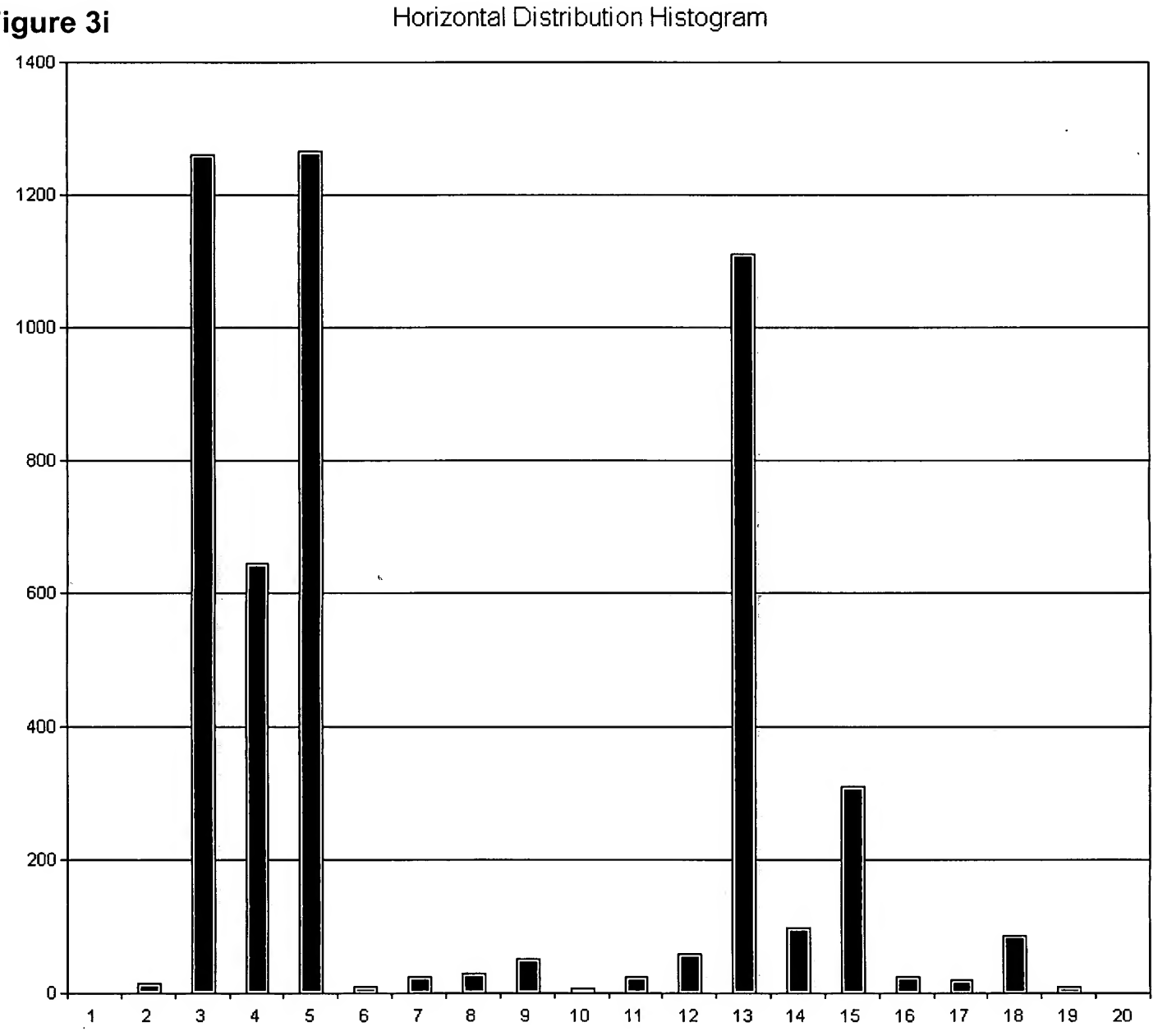
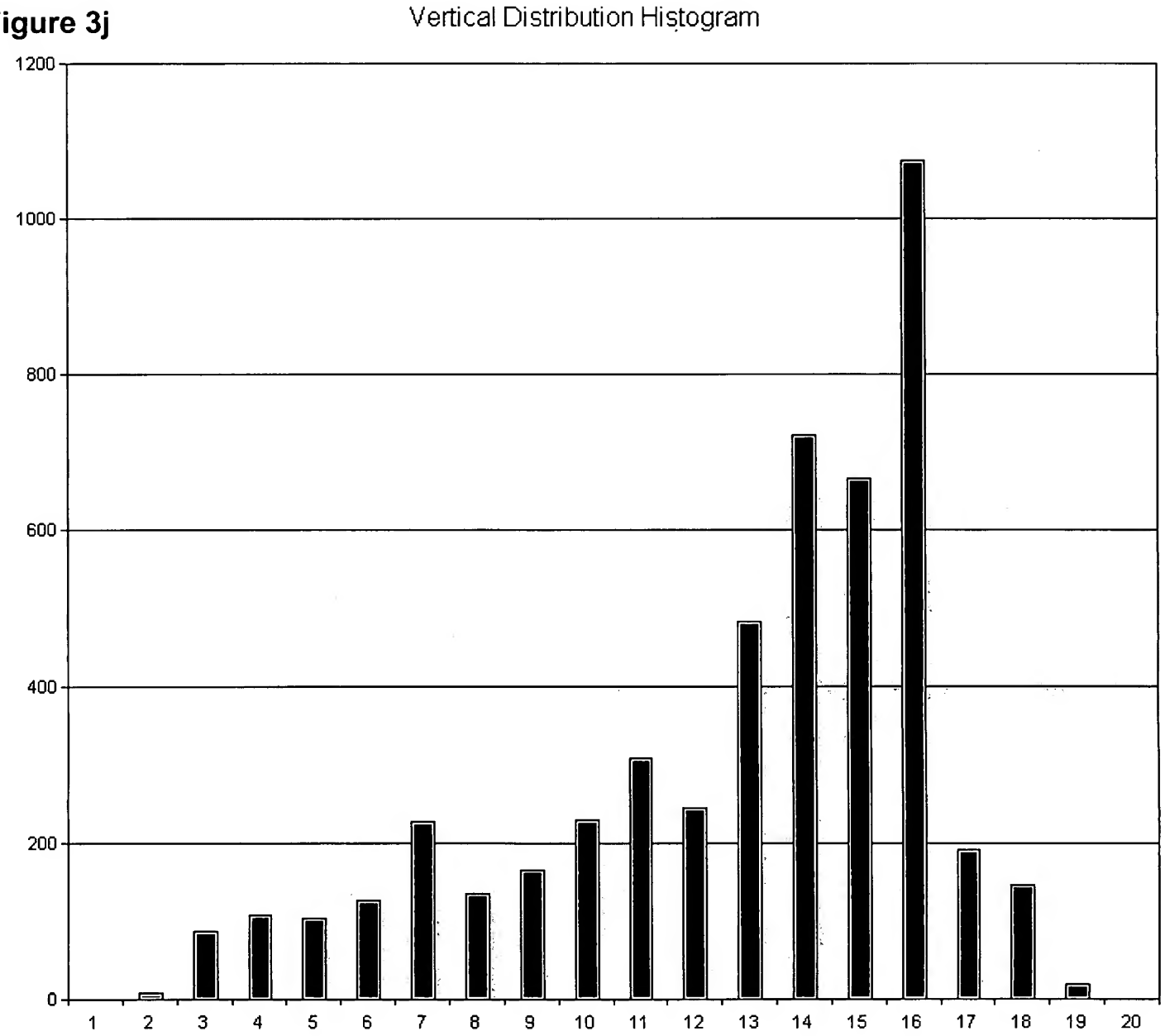

Horizontal Distribution Histogram
1400
1200
1000
800
600
400
200
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

Figure 3j


Vertical Distribution Histogram
1200
1000
800
600
400
200
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

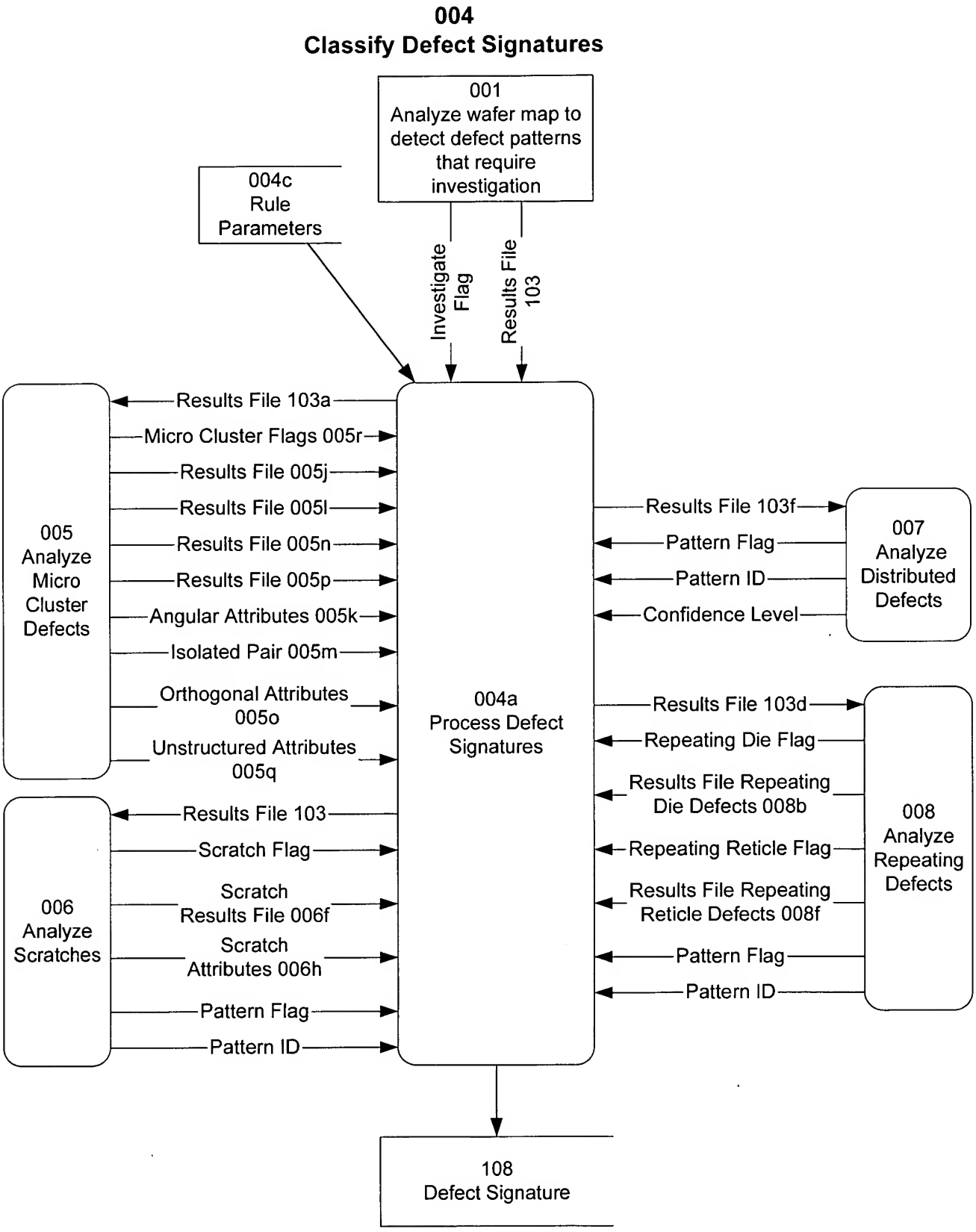

004
Classify Defect Signatures
001
Analyze wafer map to detect defect patterns that require investigation
004c
Rule
Parameters
Investigate Flag
Results File 103
005
Analyze Micro Cluster Defects
Results File 103a
Micro Cluster Flags 005r
Results File 005j
Results File 005l
Results File 005n
Results File 005p
Angular Attributes 005k
Isolated Pair 005m
Orthogonal Attributes 005o
Unstructured Attributes 005q
006
Analyze Scratches
Results File 103
Scratch Flag
Scratch Results File 006f
Scratch Attributes 006h
Pattern Flag
Pattern ID
004a
Process Defect Signatures
Results File 103f
Pattern Flag
Pattern ID
Confidence Level
007
Analyze Distributed Defects
Results File 103d
Repeating Die Flag
Results File Repeating Die Defects 008b
Repeating Reticle Flag
Results File Repeating Reticle Defects 008f
Pattern Flag
Pattern ID
008
Analyze Repeating Defects
108
Defect Signature

Figure 4

005
Analyze Micro Cluster Defects

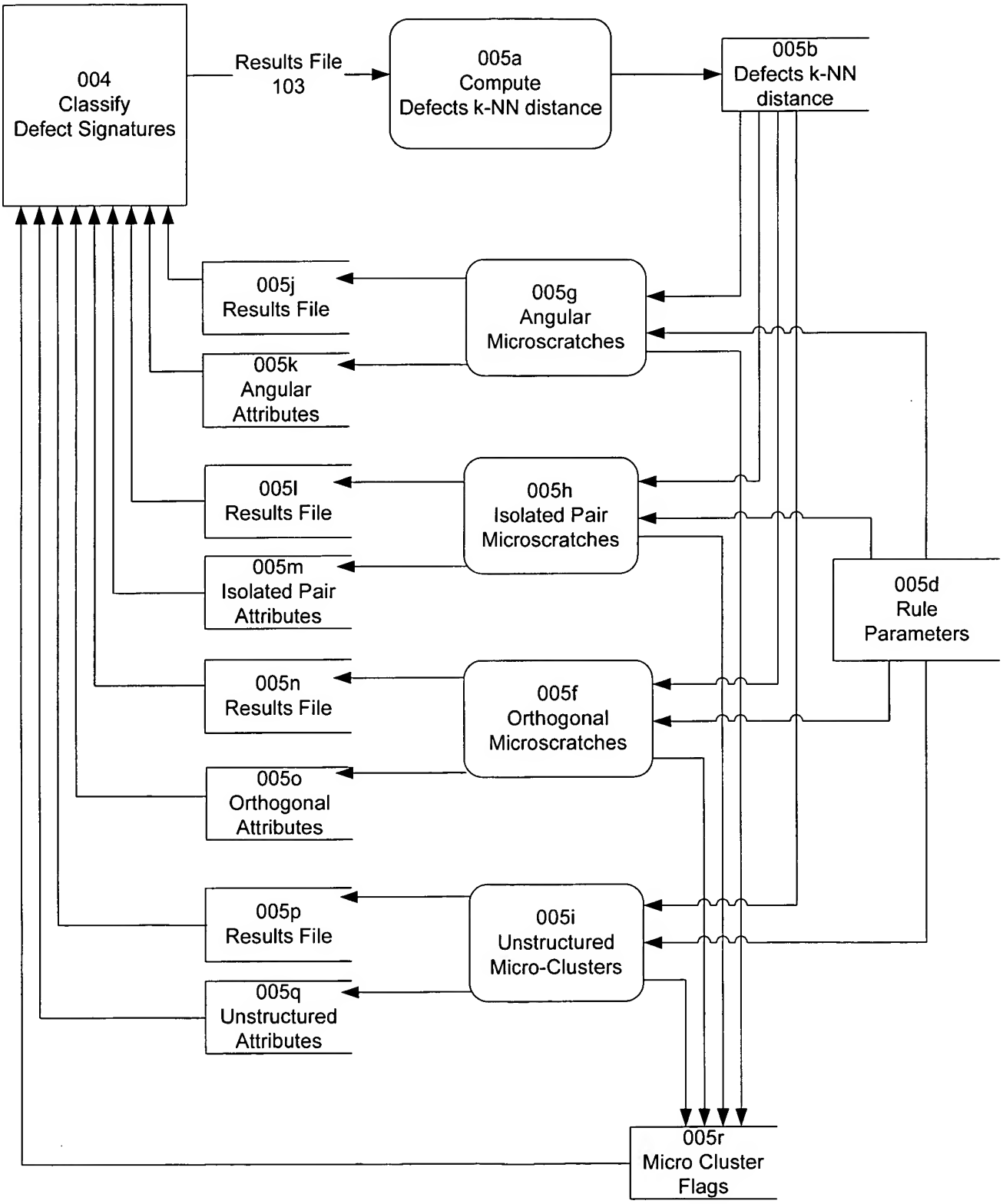


Figure 5

Figure 5a

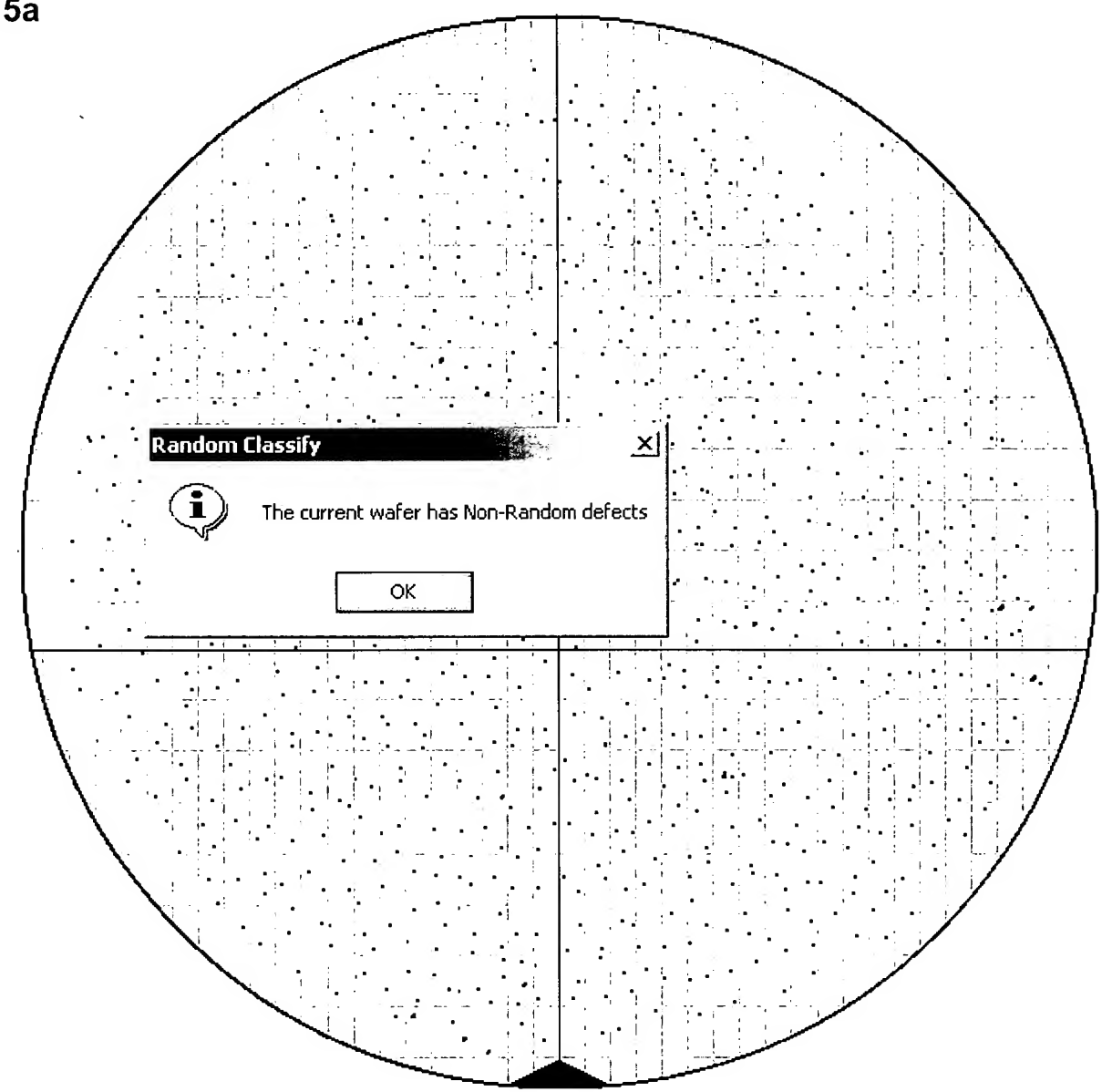

Random Classify
The current wafer has Non-Random defects
OK

Figure 5b

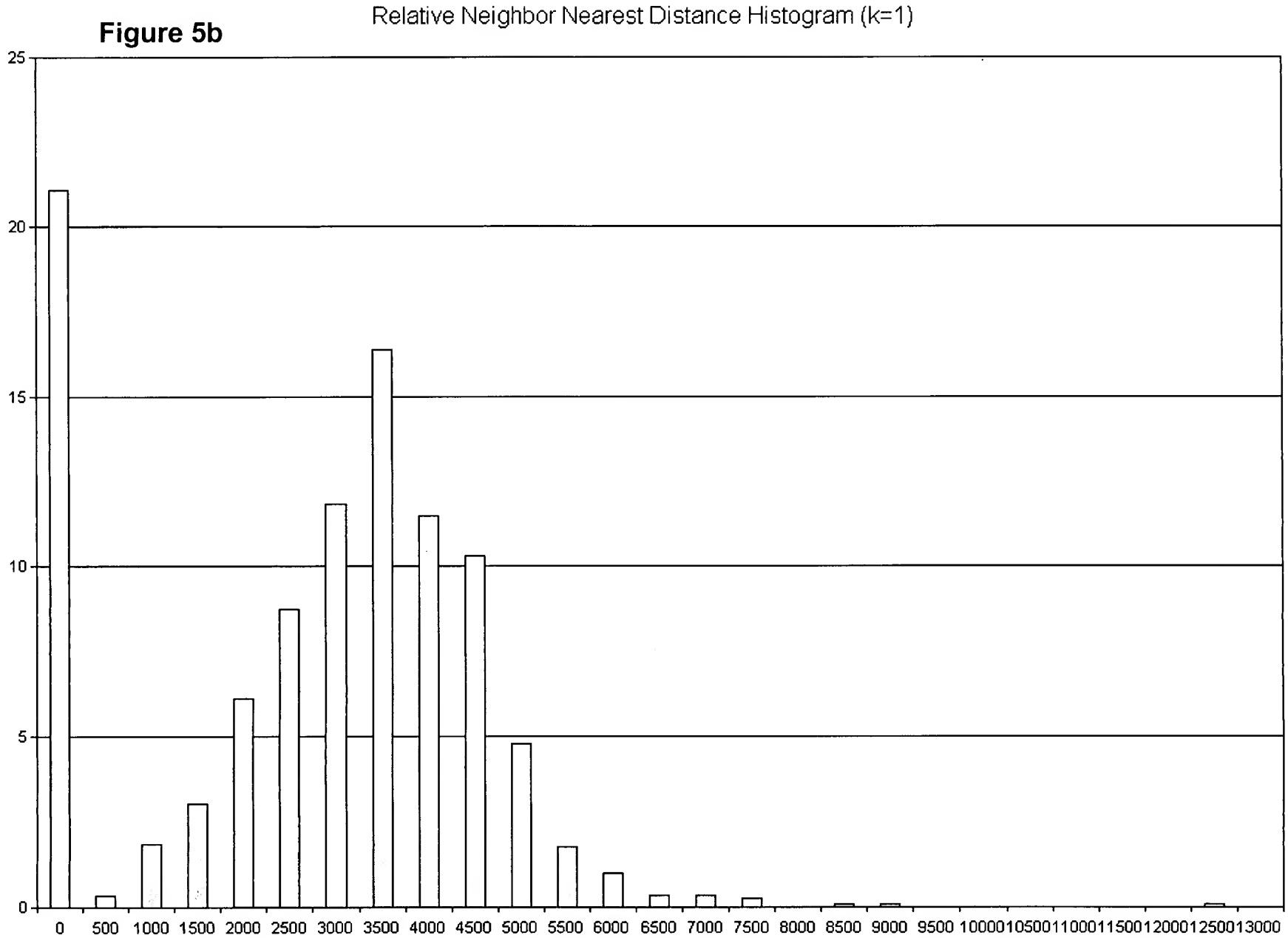

Relative Neighbor Nearest Distance Histogram (k=1)
25
20
15
10
5
0
0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500 7000 7500 8000 8500 9000 9500 10000 10500 11000 11500 12000 12500 13000

Figure 5c

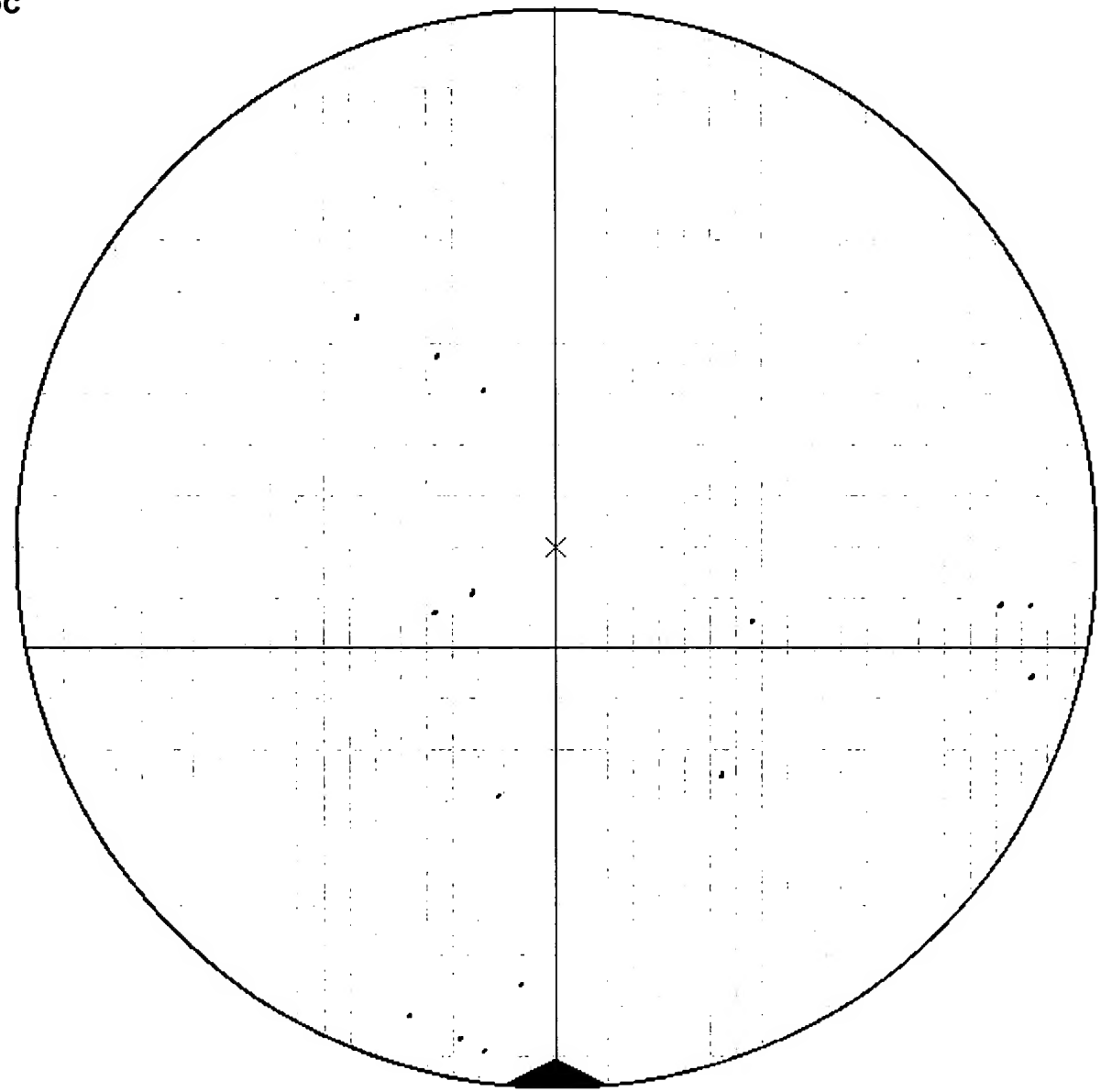
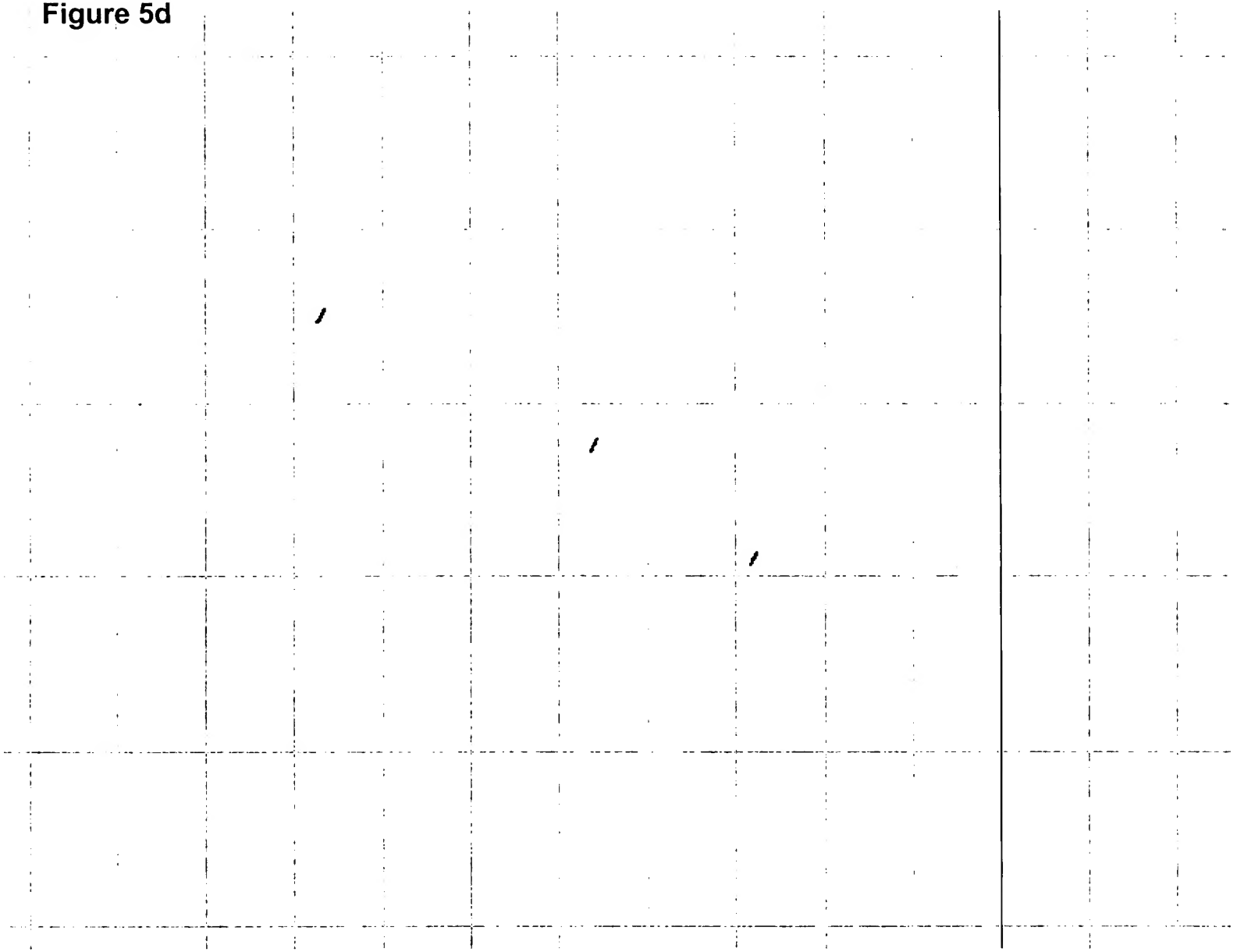


Figure 5d



006
Analyze Scratches

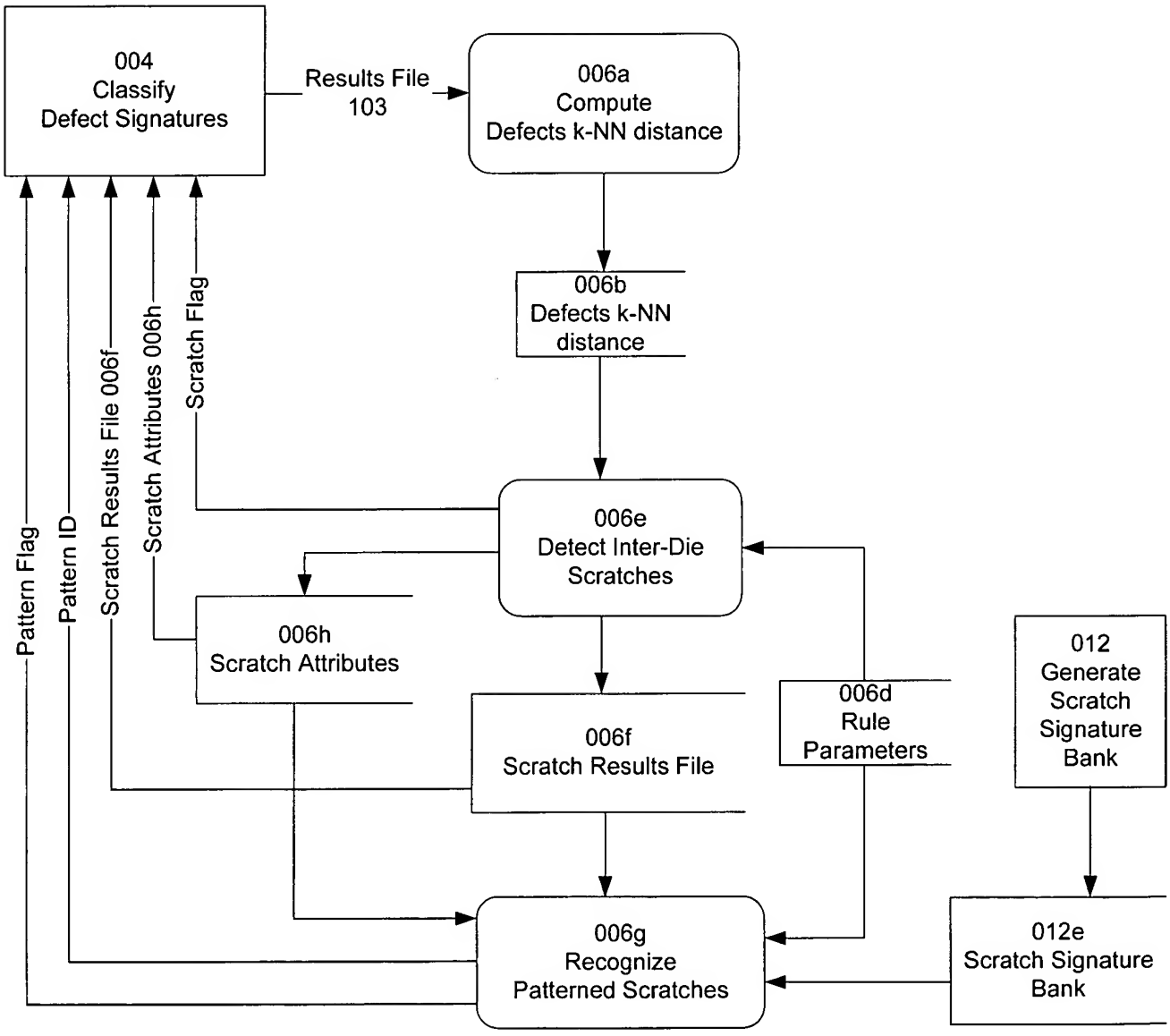


Figure 6

Figure 6a

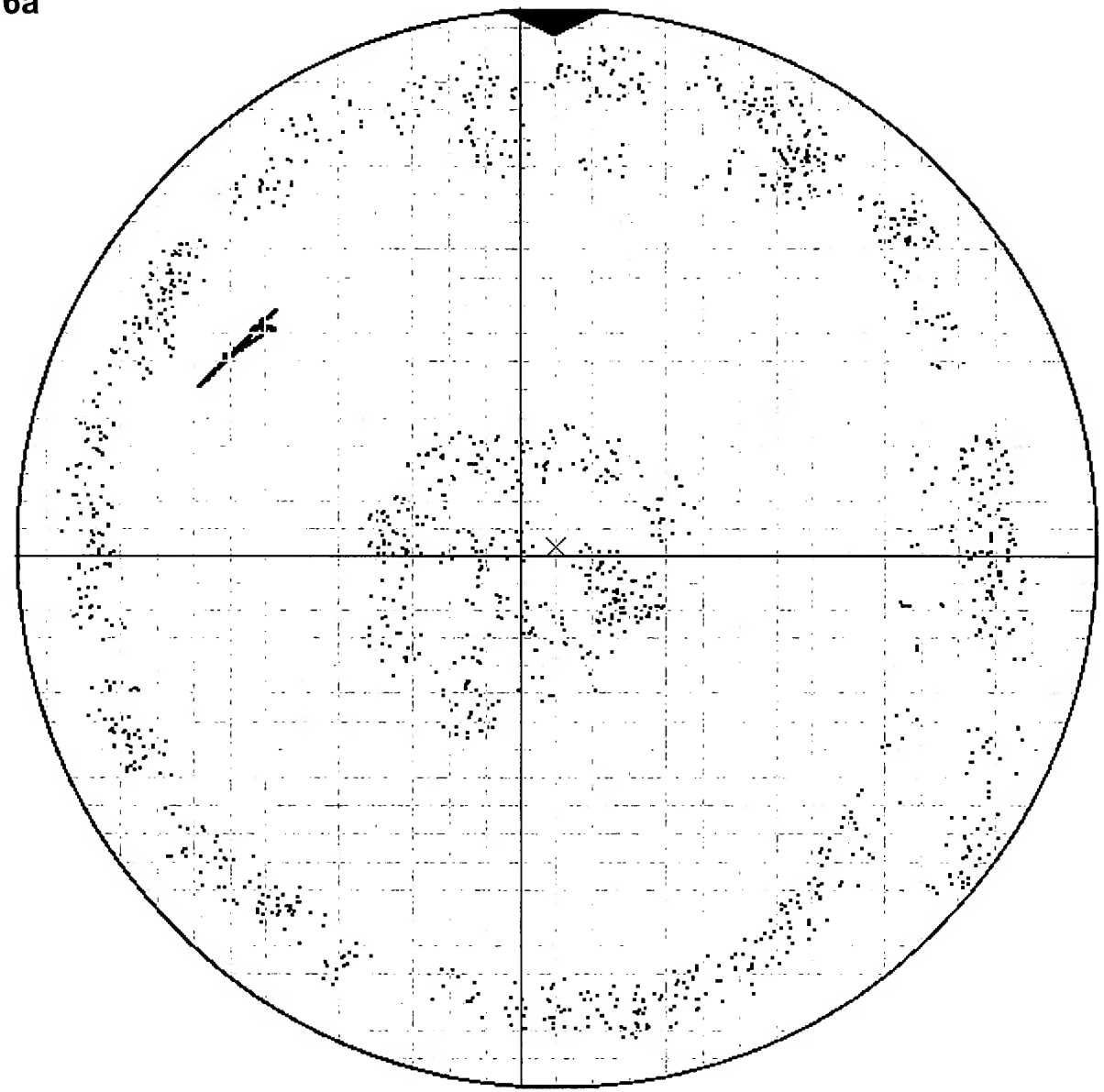


Figure 6b

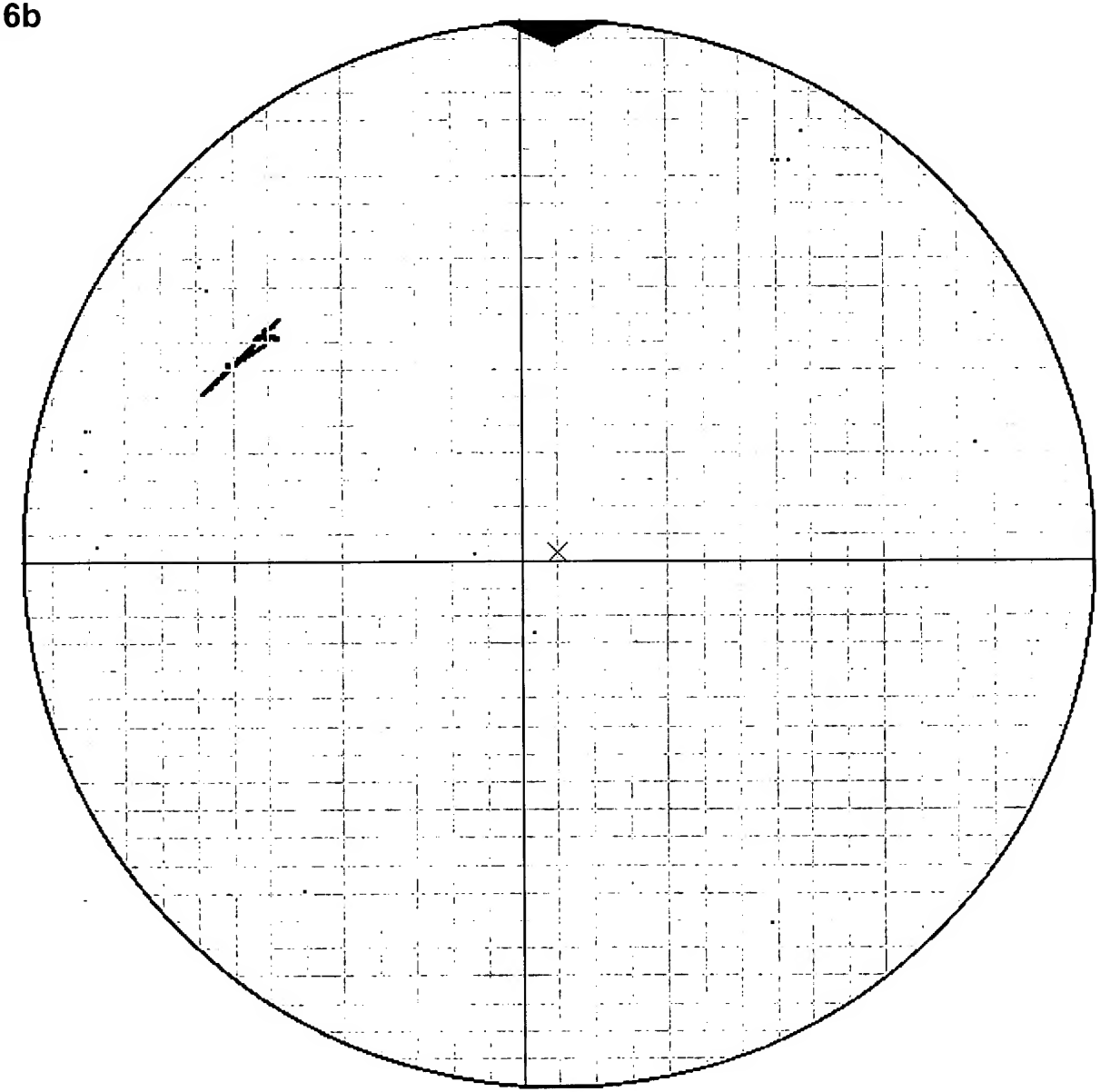


Figure 6c

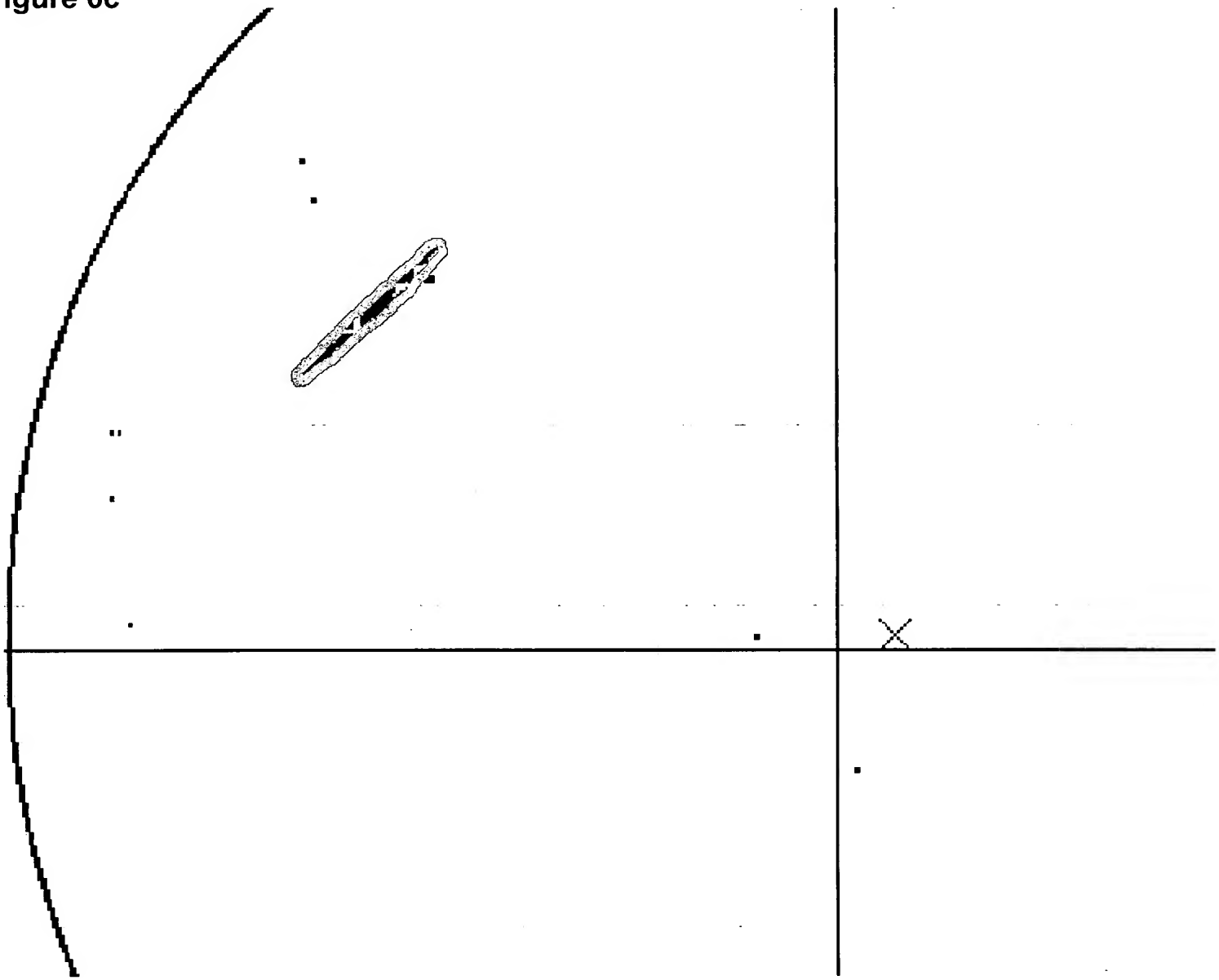


Figure 6d

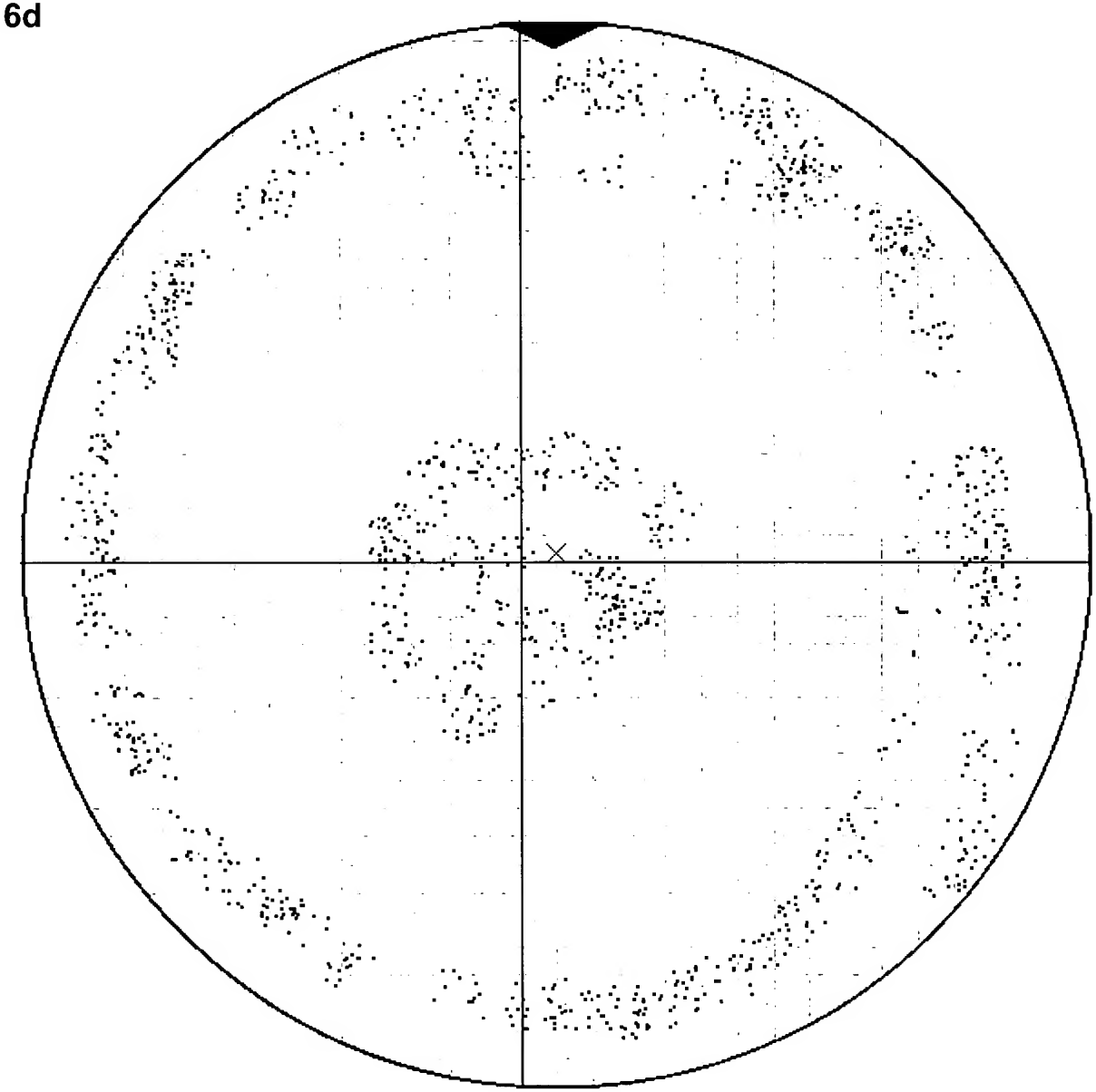


Figure 6e

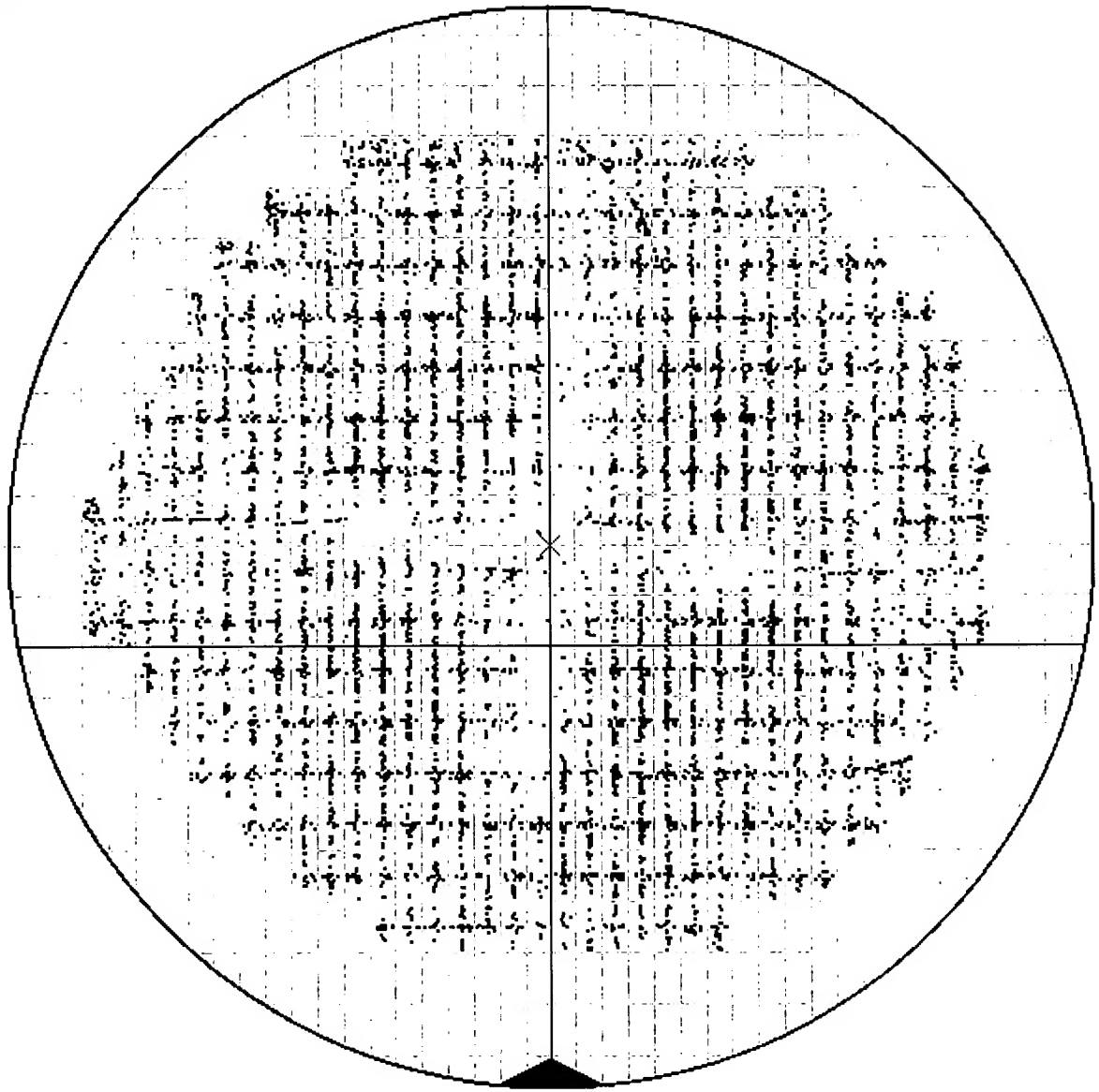


Figure 6f

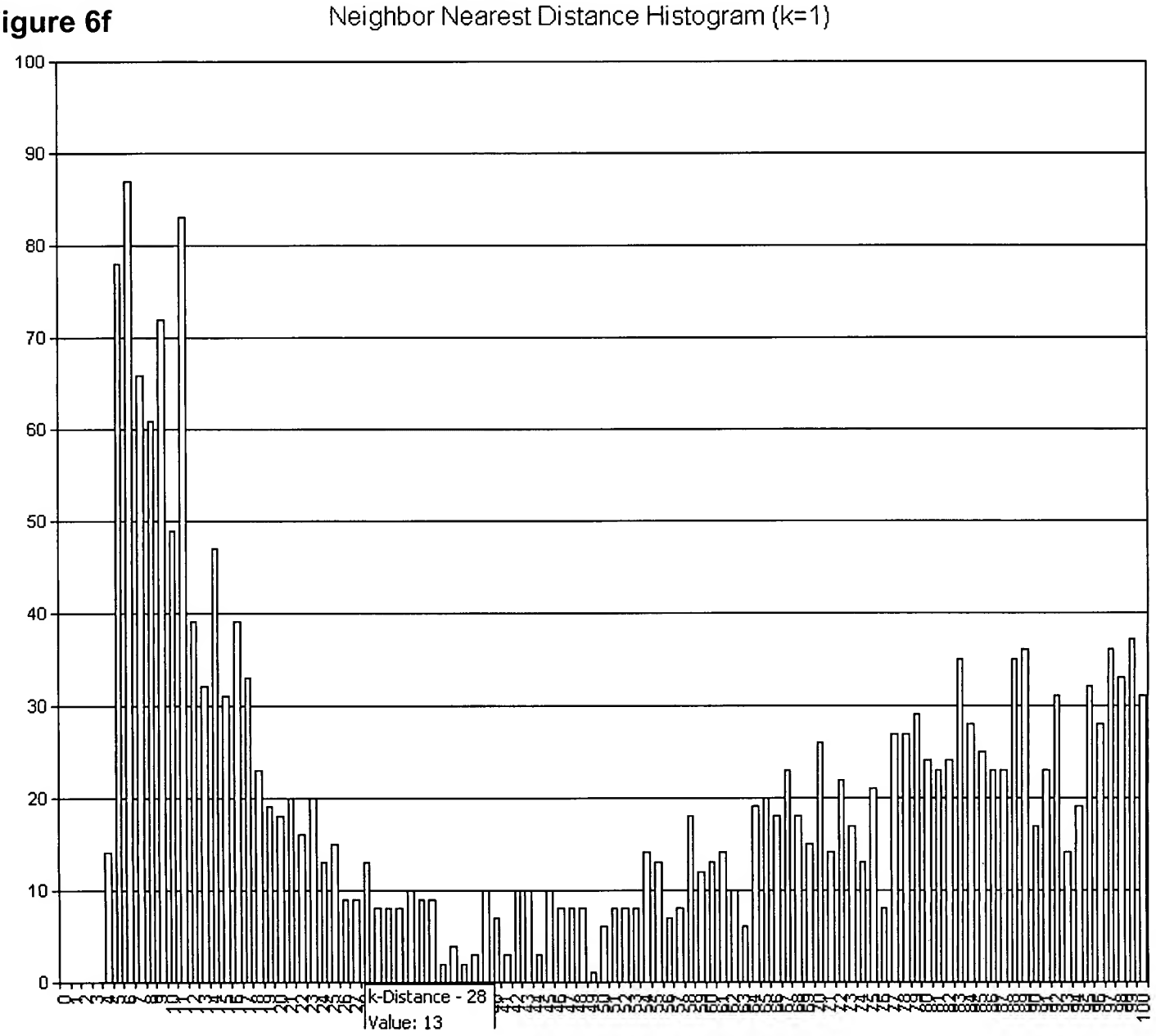

Neighbor Nearest Distance Histogram (k=1)
100
90
80
70
60
50
40
30
20
10
0
k-Distance - 28
Value: 13

Figure 6g

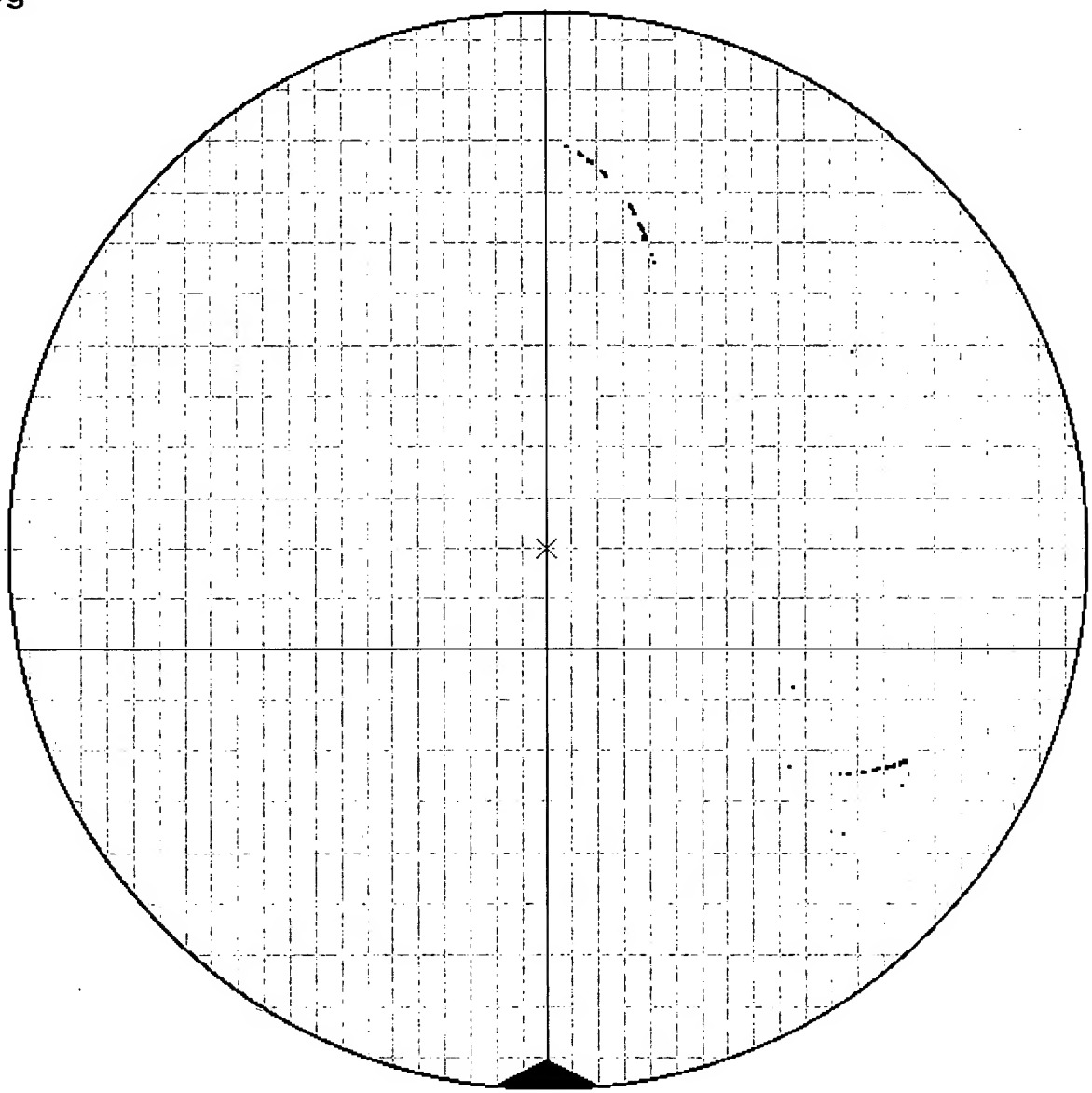


Figure 6h

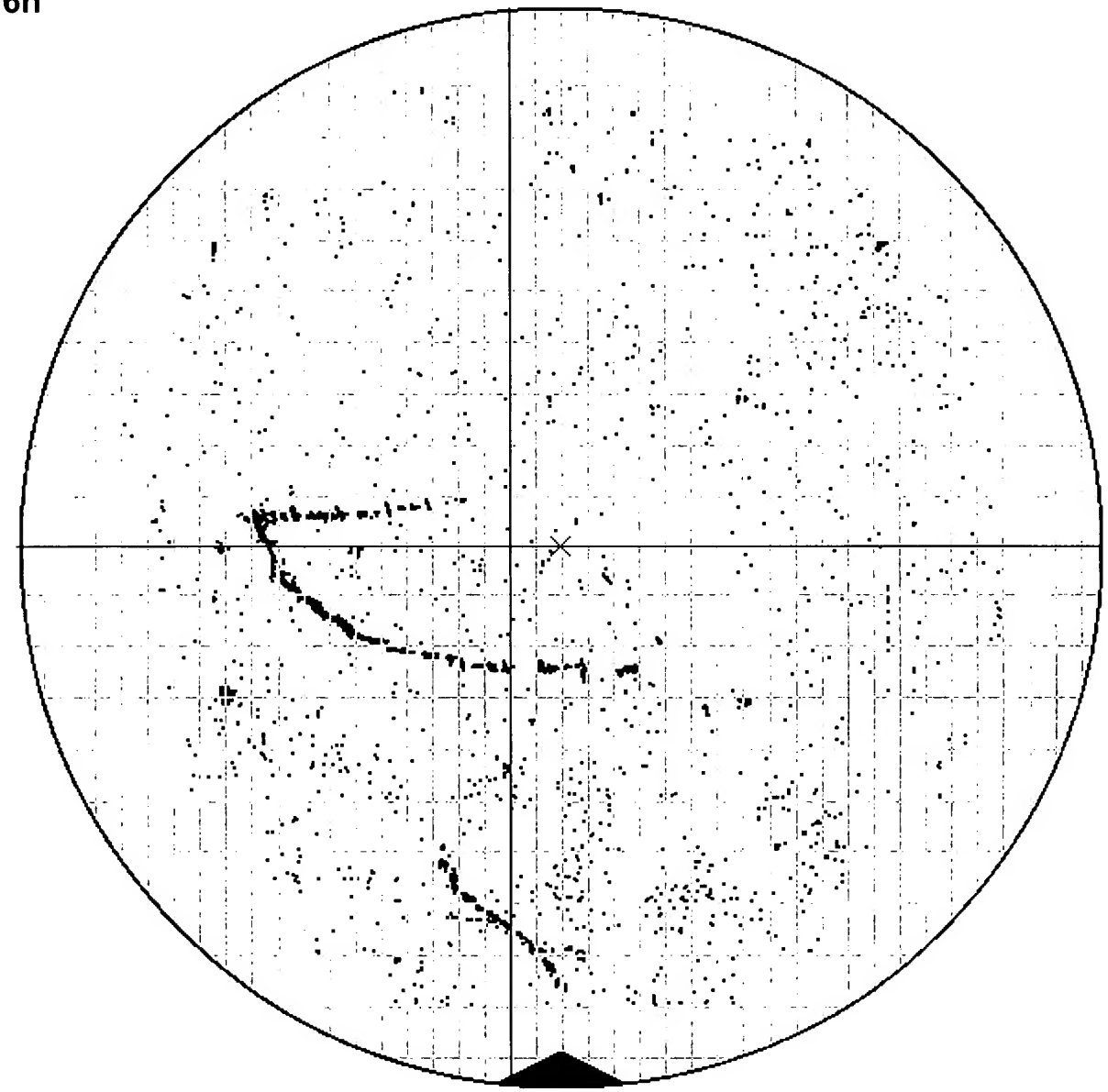
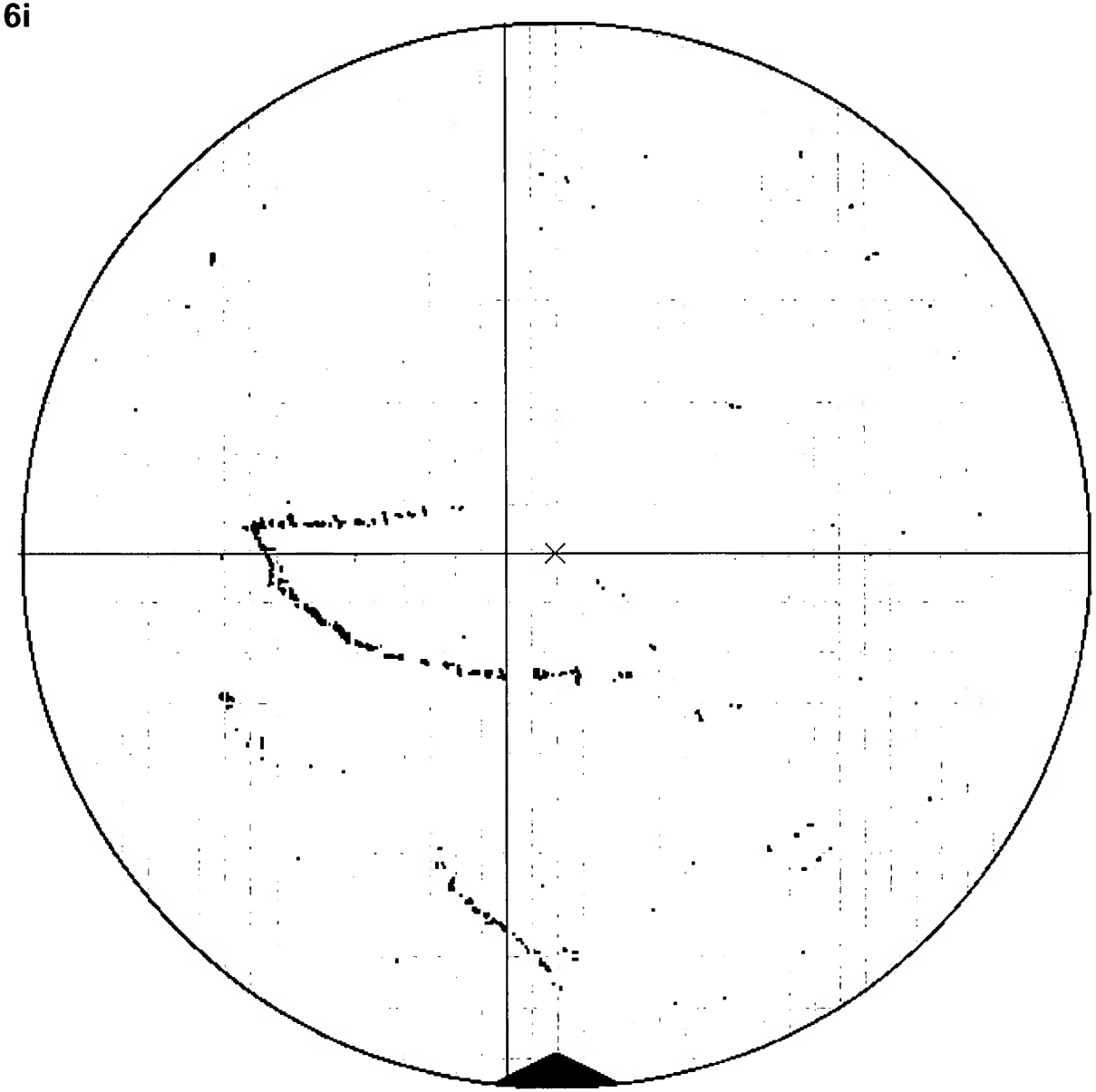


Figure 6i



007
Analyze Distributed Defects

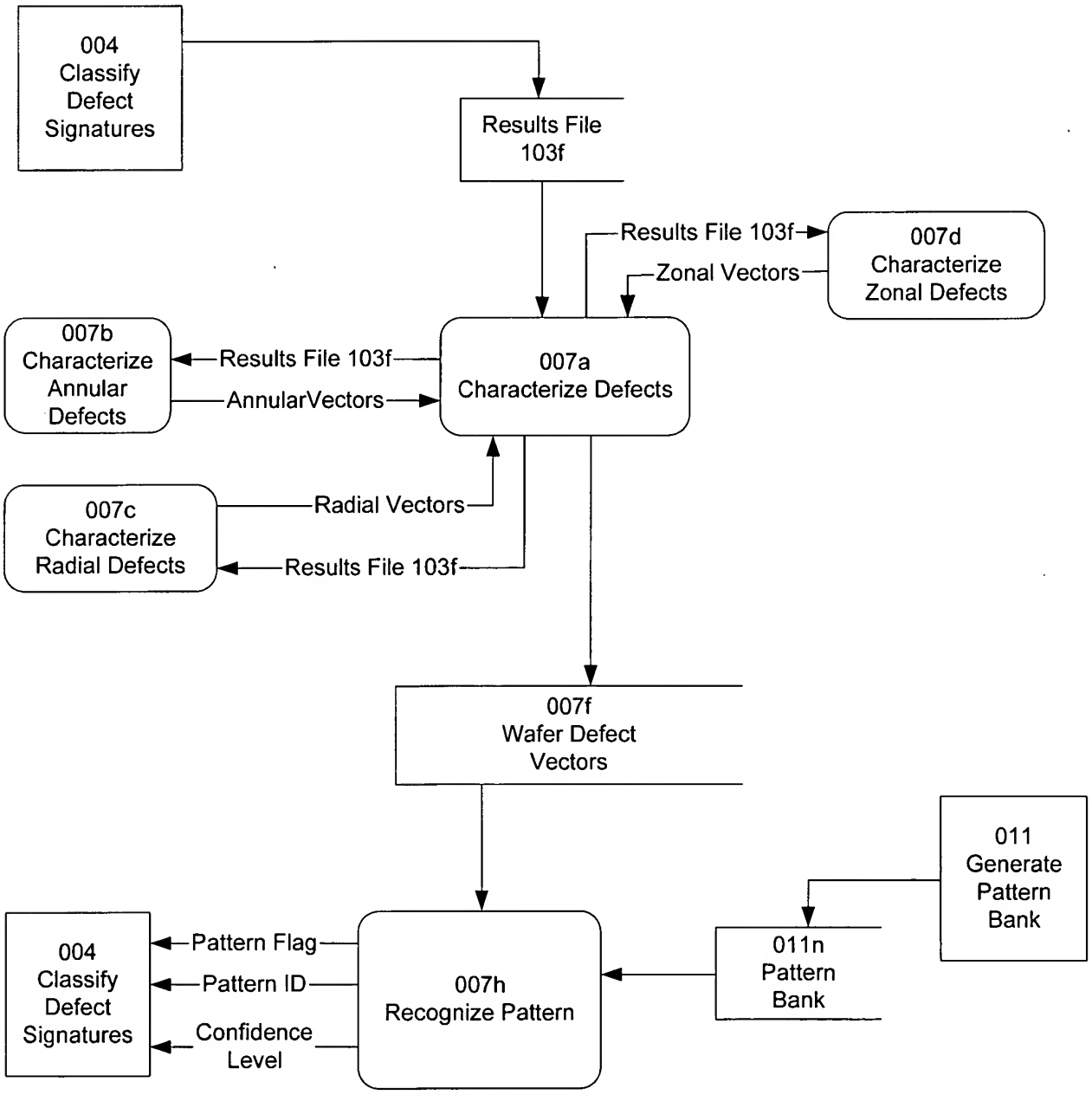
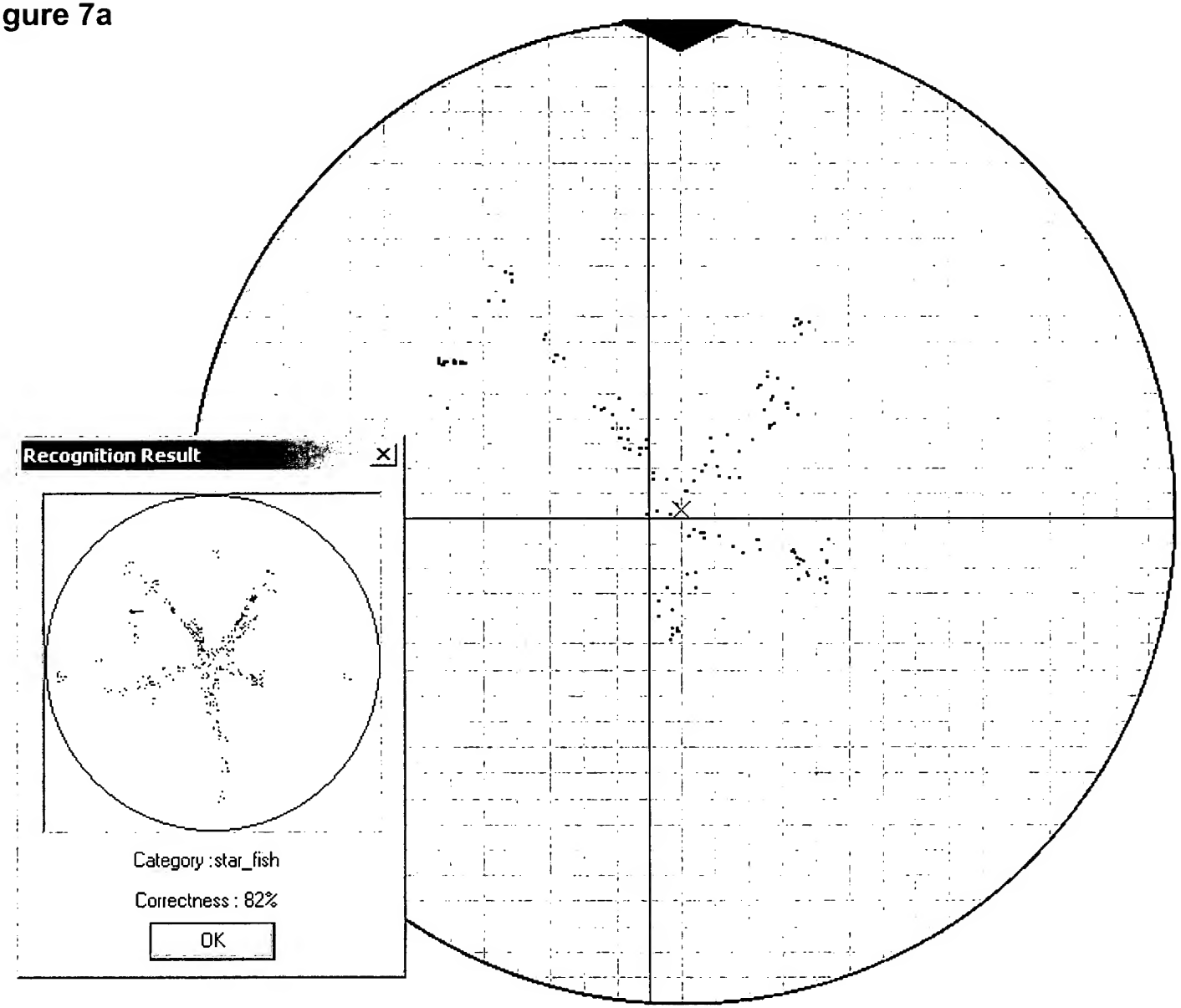


Figure 7

Figure 7a



008
Analyze Repeating Defects

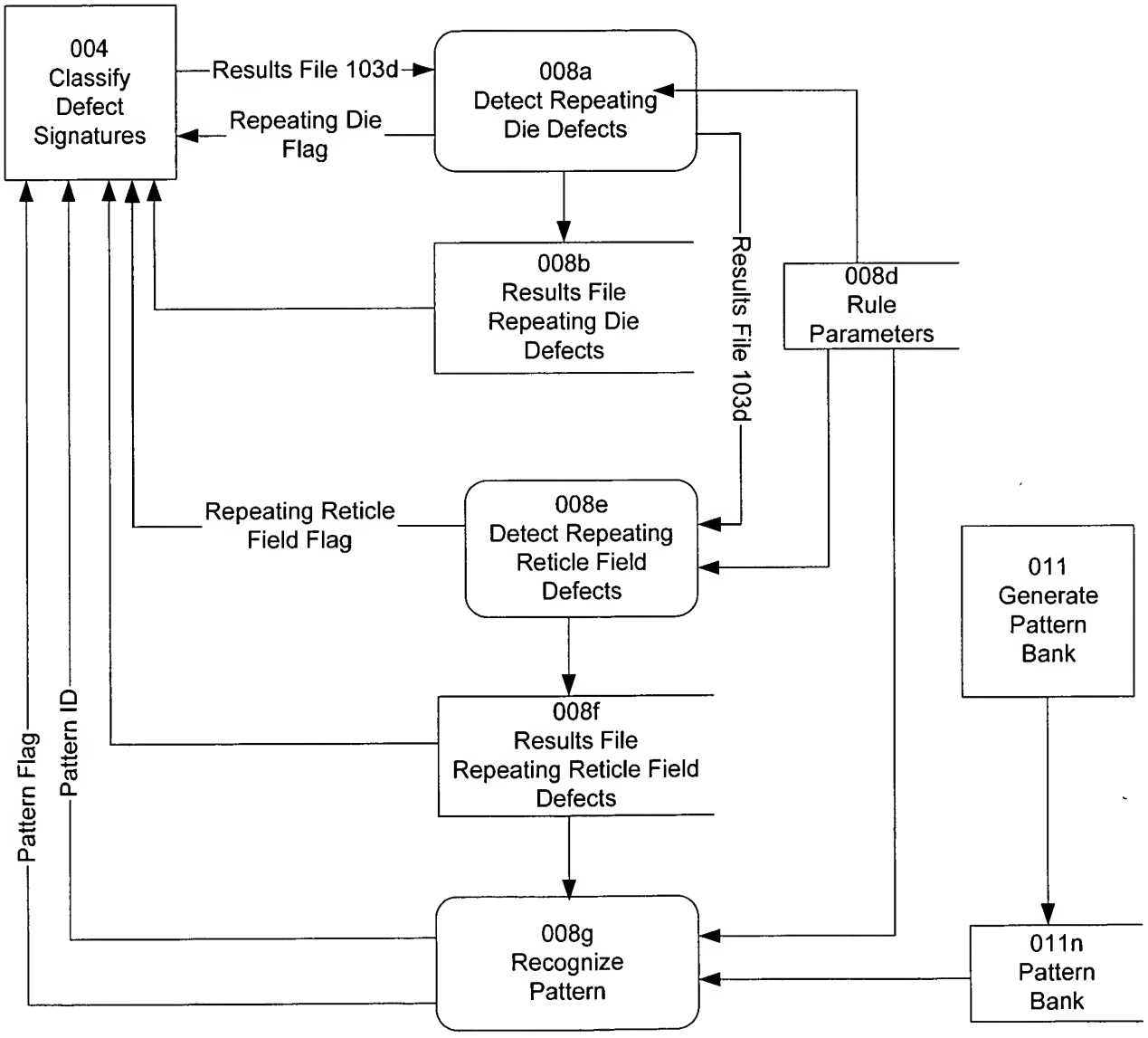


Figure 8

Figure 8a

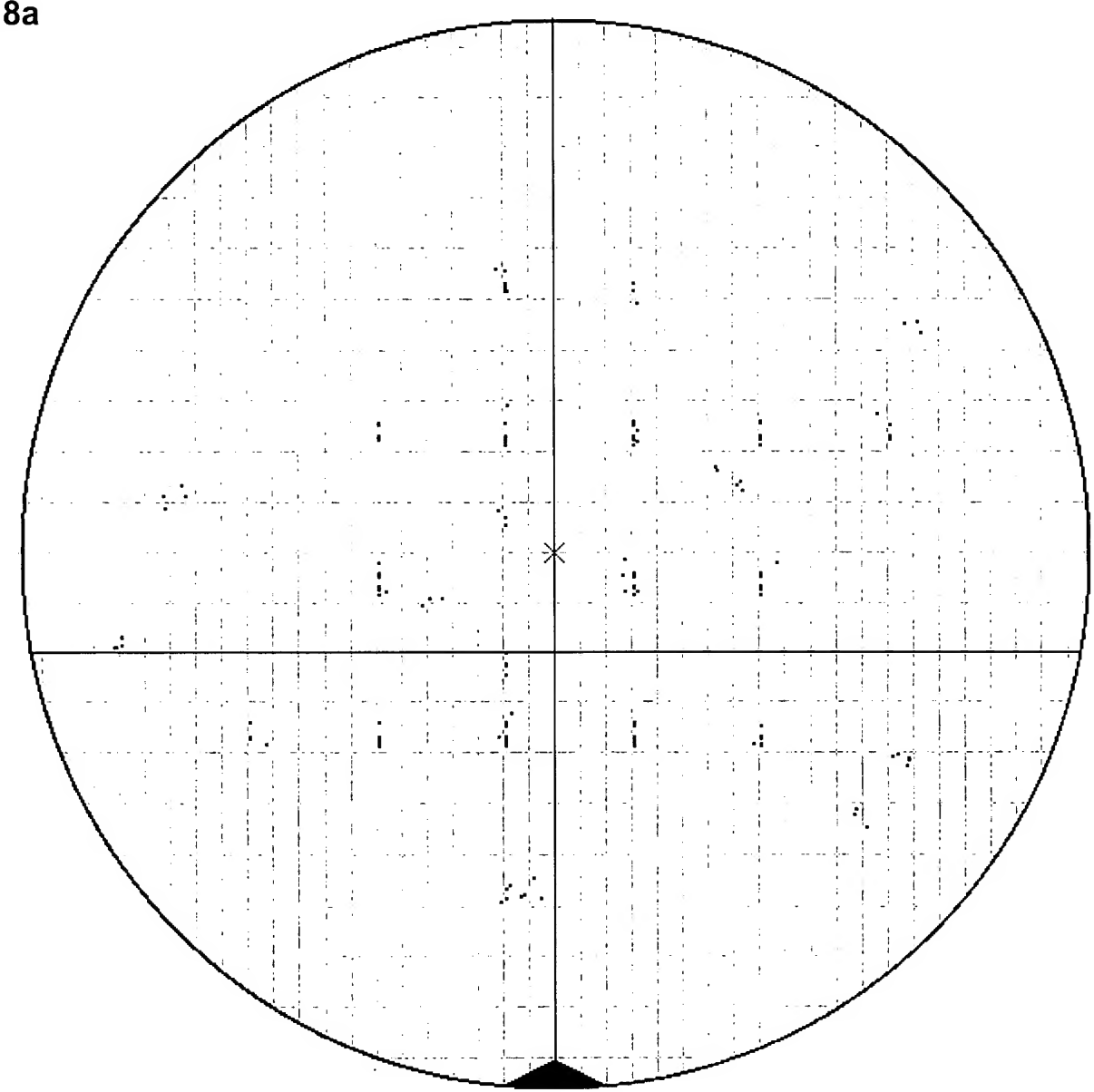


Figure 8b

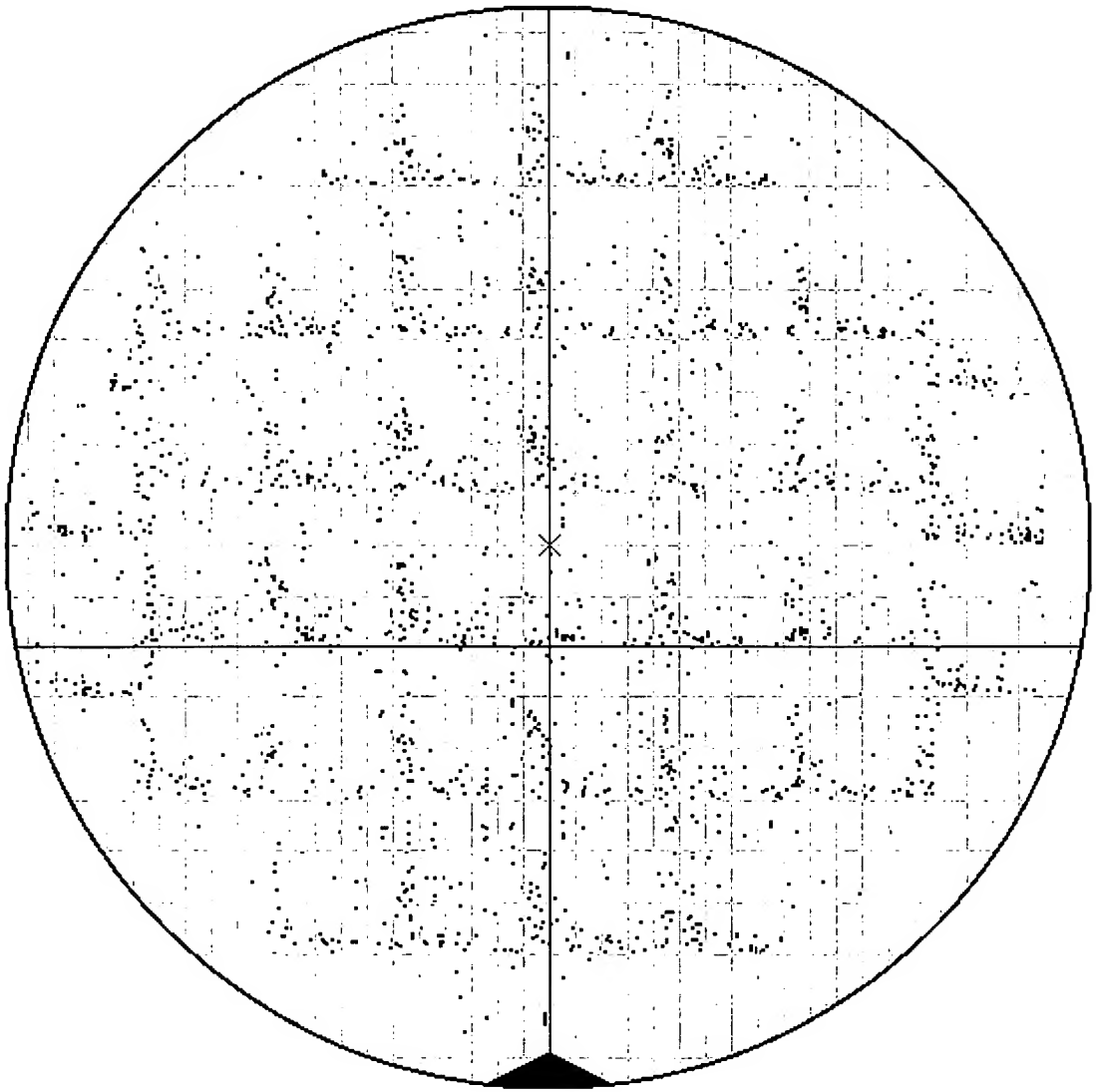


Figure 8c

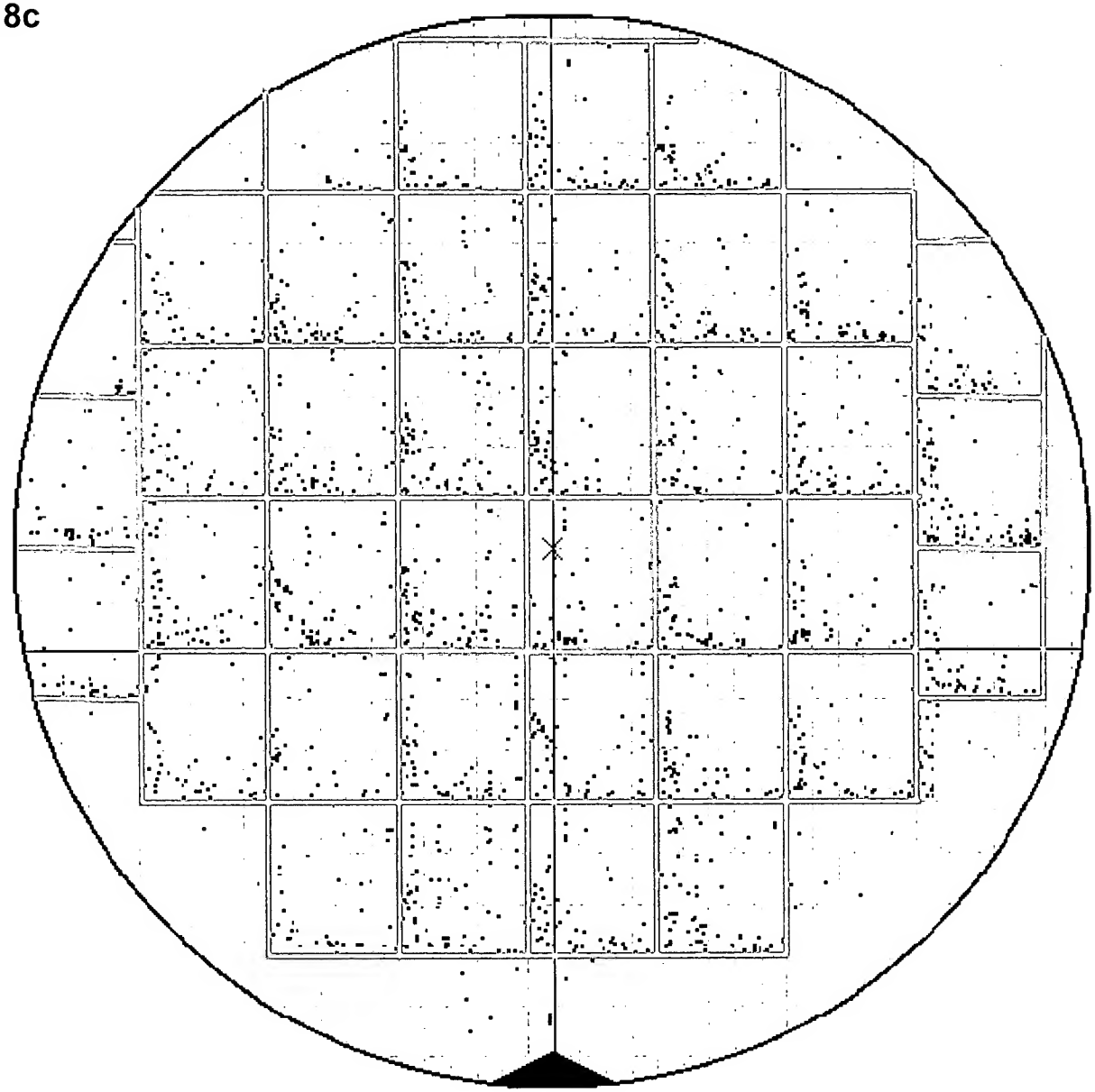
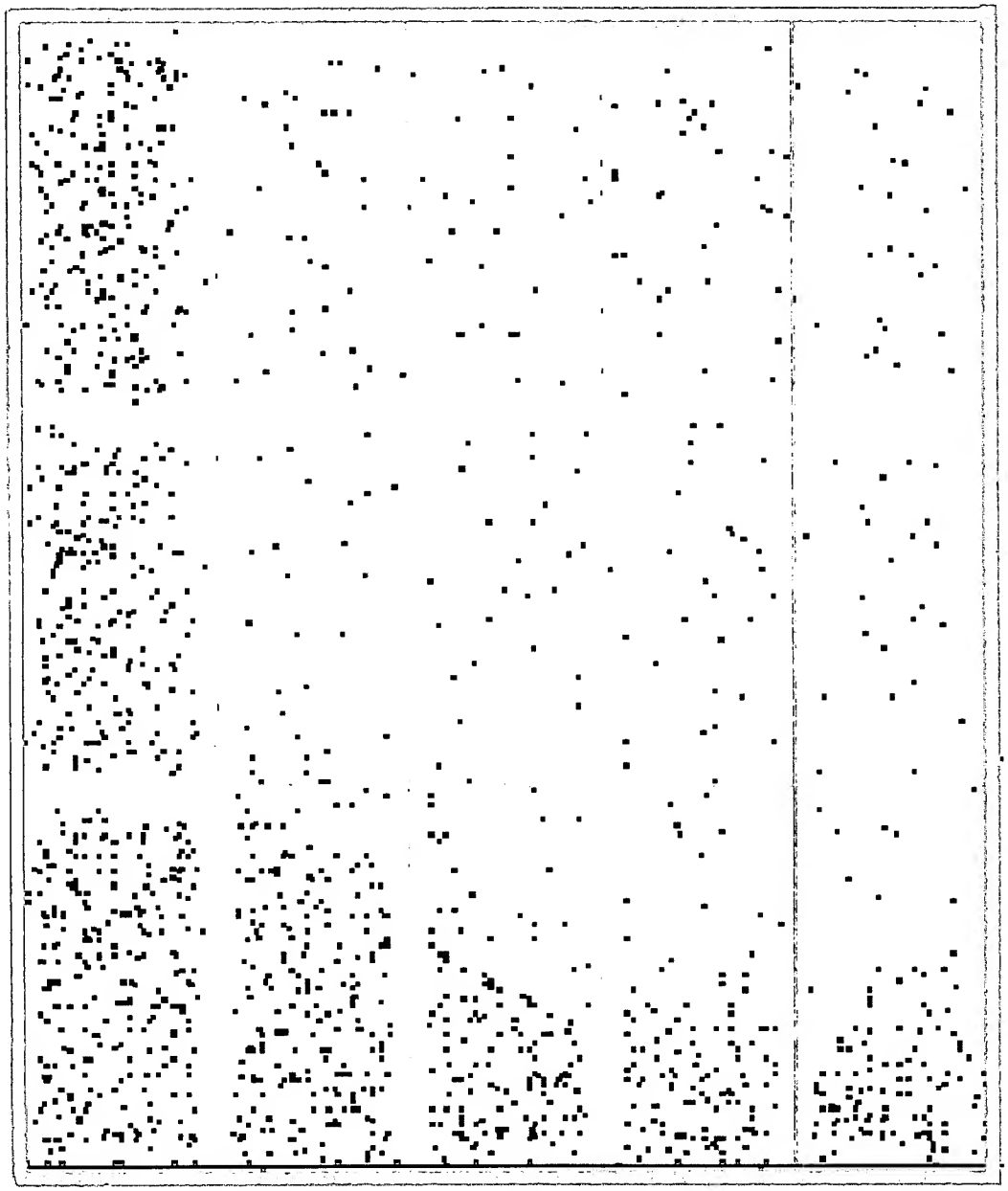


Figure 8d



010
Intelligent Process Control

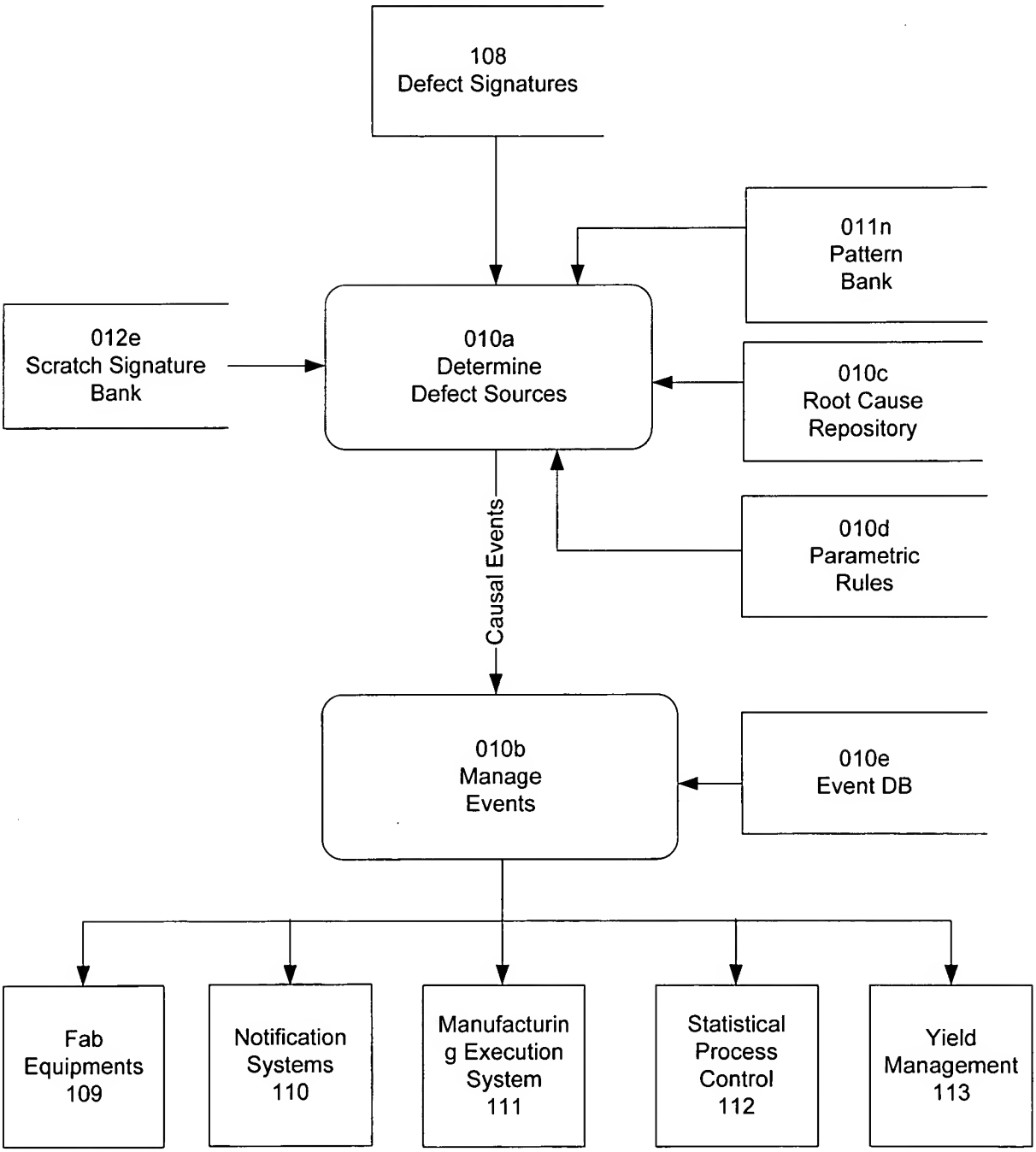


Figure 9

011
Generate Pattern Bank

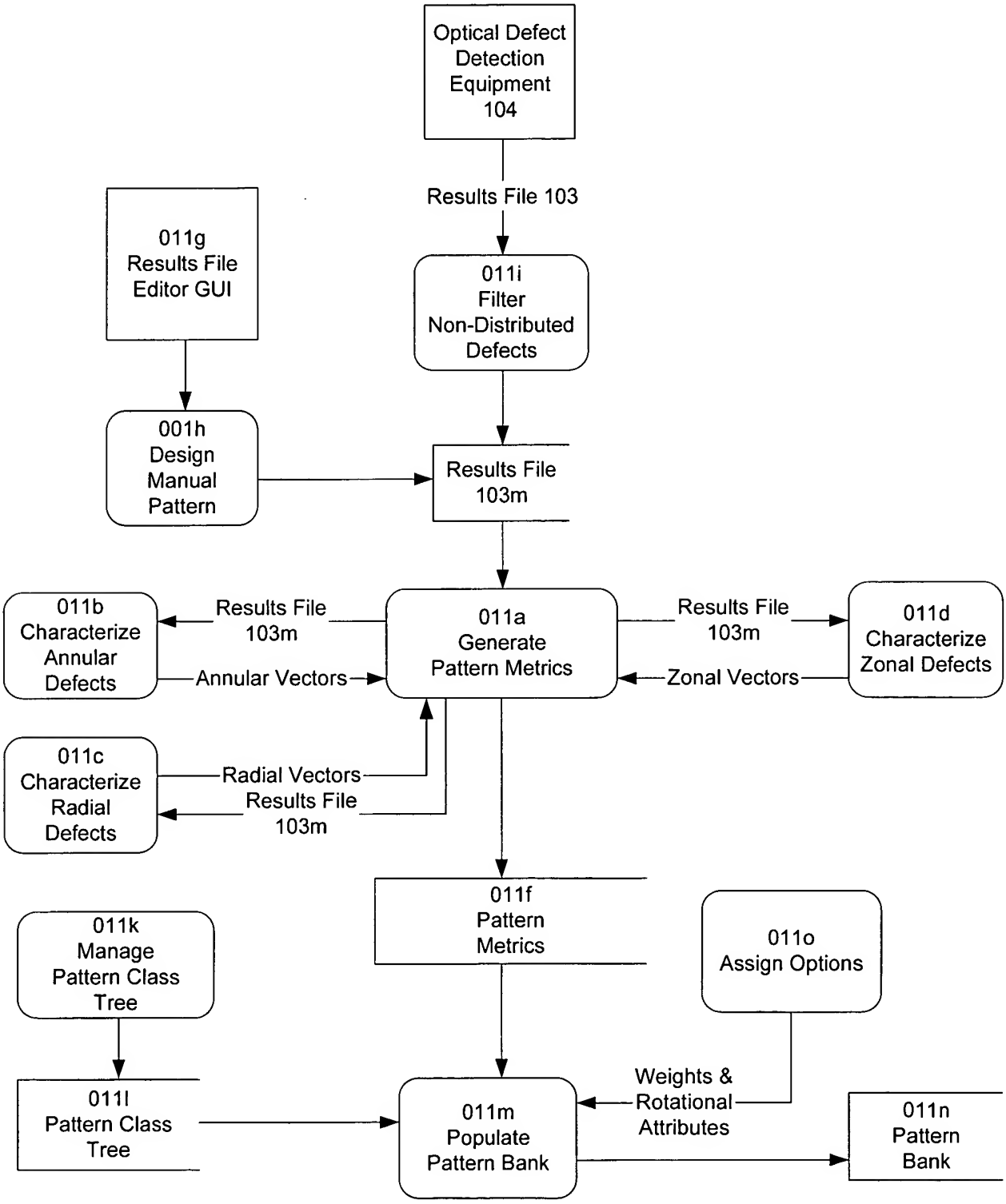


Figure 10

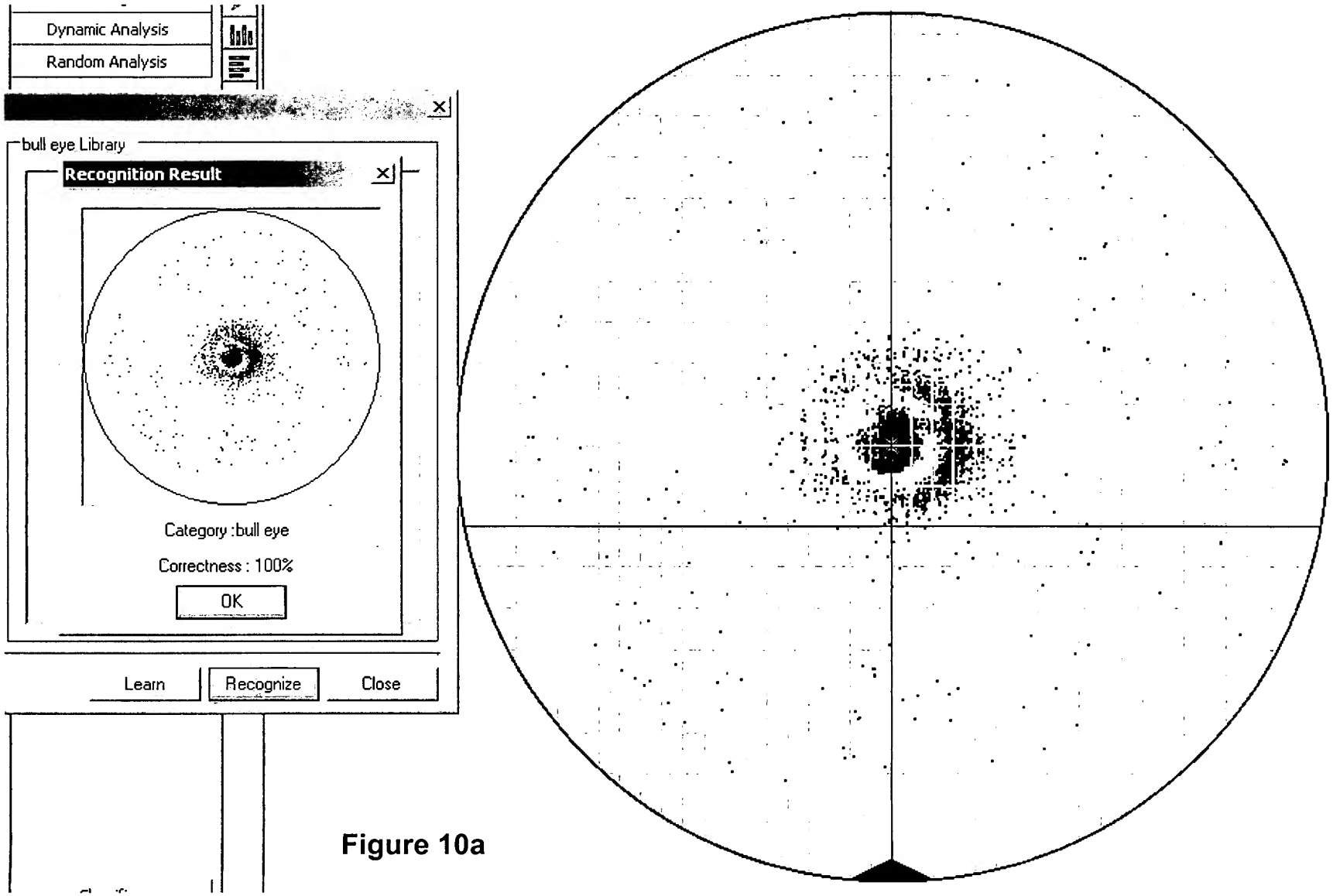

Dynamic Analysis
Random Analysis
bull eye Library
Recognition Result
Category :bull eye
Correctness : 100%
OK
Learn
Recognize
Close

Figure 10a

012
Generate Scratch Signature Bank

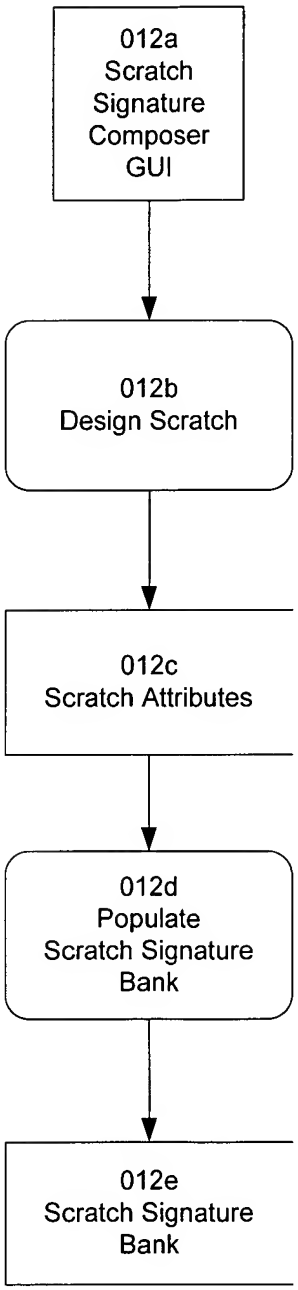


Figure 10b

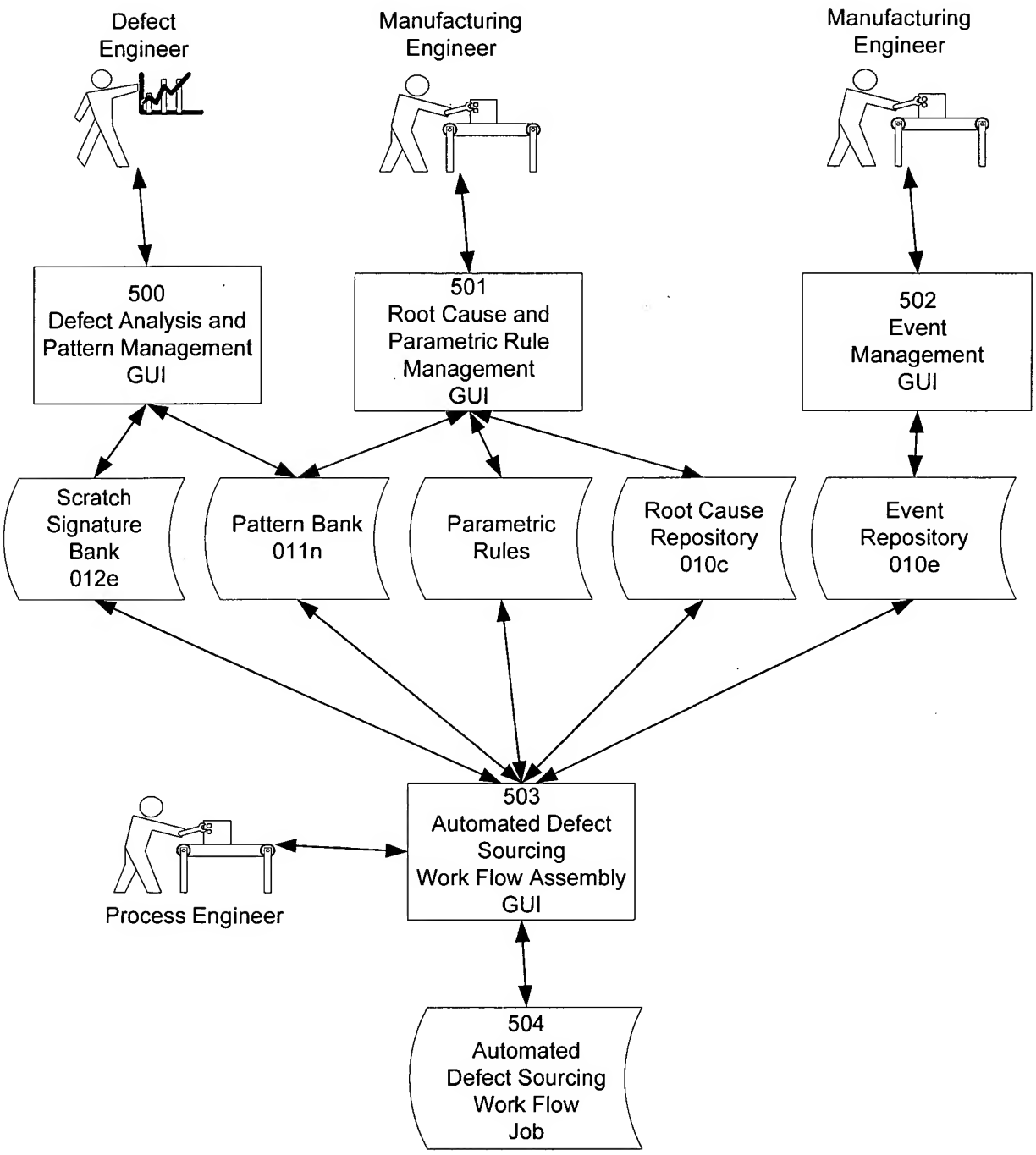

Automated Defect Sourcing GUI Components
Defect Engineer
Manufacturing Engineer
Manufacturing Engineer
500 Defect Analysis and Pattern Management GUI
501 Root Cause and Parametric Rule Management GUI
502 Event Management GUI
Scratch Signature Bank 012e
Pattern Bank 011n
Parametric Rules
Root Cause Repository 010c
Event Repository 010e
503 Automated Defect Sourcing Work Flow Assembly GUI
Process Engineer
504 Automated Defect Sourcing Work Flow Job

Figure 11

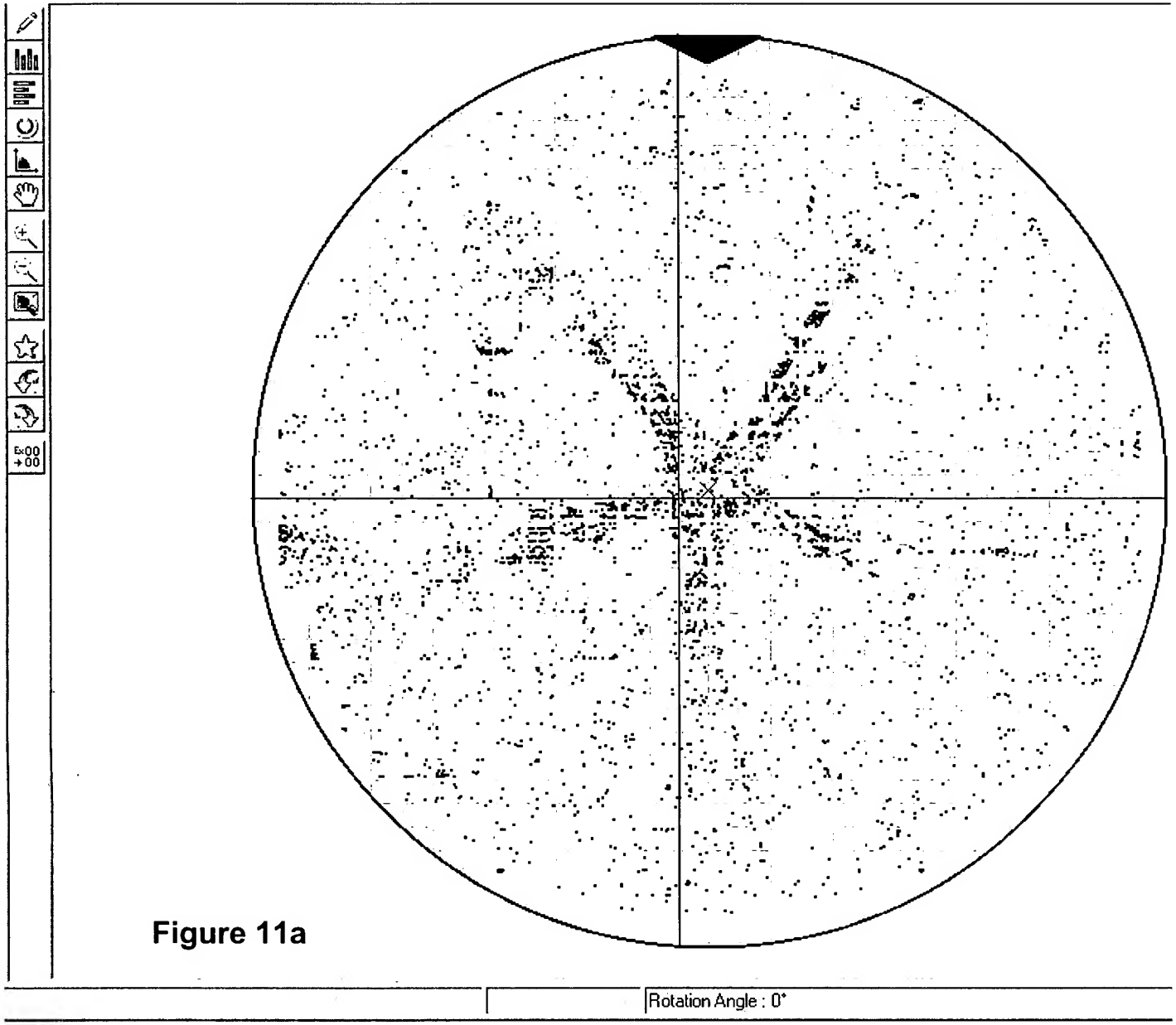


Figure 11a

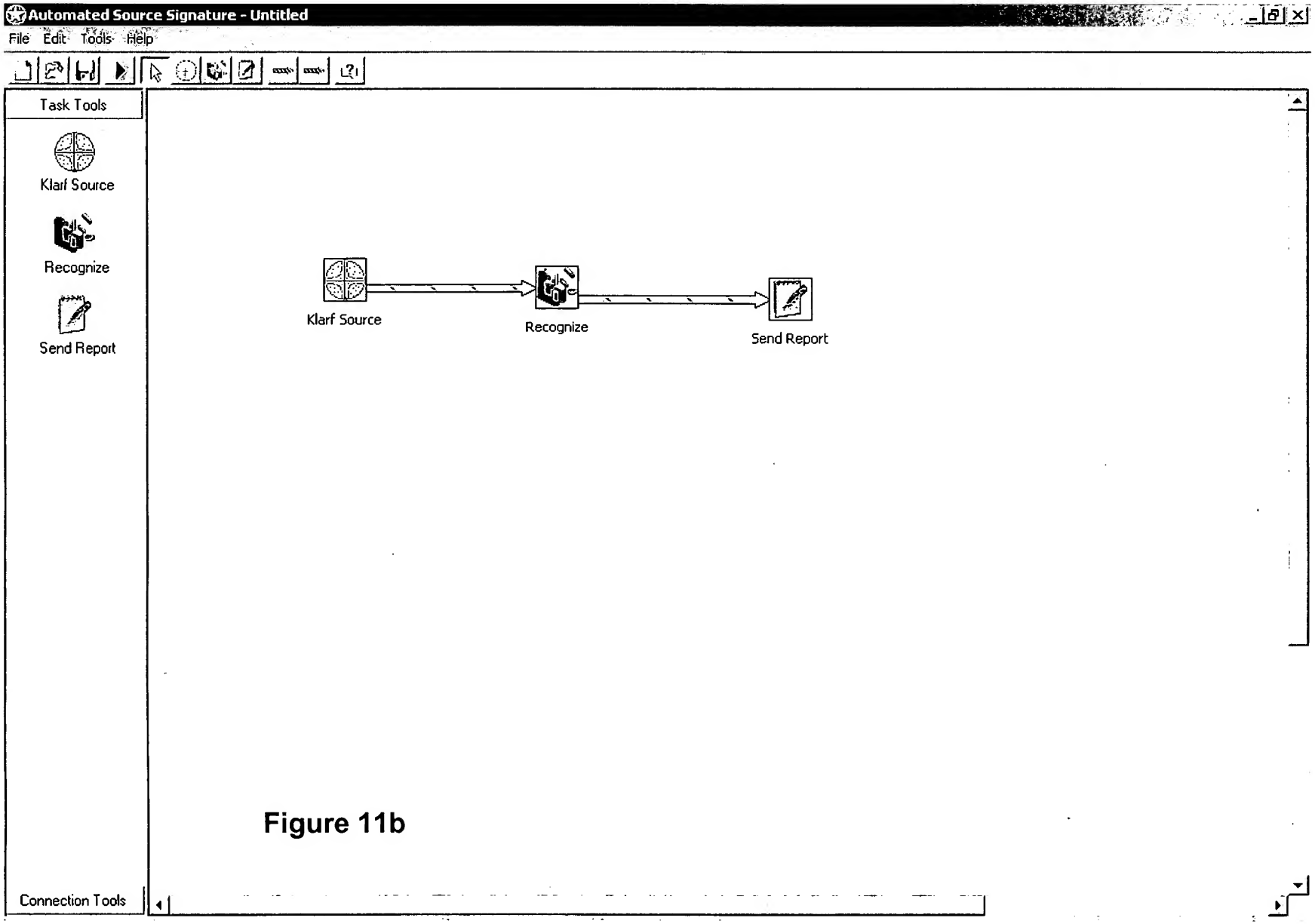

Automated Source Signature - Untitled
File Edit Tools Help
Task Tools
Klarf Source
Recognize
Send Report
Connection Tools
Klarf Source
Recognize
Send Report

Figure 11b